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The Politics of Naval Innovation

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This study examines how innovations in technology and doctrine can help trigger revolutions in military affairs by studying historical cases of how technologically advanced systems found their way from the drawing board to the fleet. The cases studied are the Tomahawk cruise missile and the Aegis combat system. The research analyzes the advocacy techniques used to advance these systems and does so through a combined political science/organizational theory lens.

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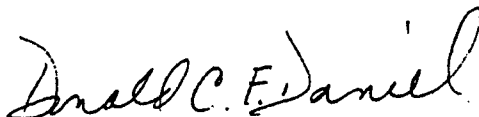
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THE POLITICS OF NAVAL INNOVATION

The value of this study for students of revolutions in military affairs is found in its reexamination of past theories of innovation by testing them against new case studies. Although no one theory emerged superior, the authors of this report found many of the points raised by previous studies to be applicable to today's new security environment. The authors also strike a note of caution. Even though there seems to be a consensus that innovation is needed in order for the US to maintain the world's most powerful and sophisticated military, there are pitfalls which, if not avoided, could result in stagnation.

This stagnation could come about as a result of numerous trends, including: the traditional drawdown following the conclusion of a conflict (in this case, the Cold War) with no new peer competitor looming on the horizon; a fiscally constrained environment (which threatens to cut research and development funds and consolidate or eliminate laboratories, war colleges, etc.); the increasing move towards centralized control of programs and doctrine (as a result of the Goldwater-Nichols legislation); the military's aversion to innovative mavericks (i.e., a Rickover syndrome); and the fact that fewer and fewer politicians and political appointees have any military experience.

Several counter-trends offer some hope that the US military will remain innovative. Individuals, such as Andrew Marshall, Director of Net Assessment in the Office of the Secretary of Defense, are helping to raise awareness of the issues surrounding innovation. There is also the historical theory that long periods of peace are the most fertile for fomenting revolutions in military affairs. Even so, the implications of many of the current trends noted in this volume are worth consideration.



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Chapter 1

INTRODUCTION

Bradd C. Hayes

The central concern of this paper is how innovations (either in technology, doctrine or both) trigger revolutions in military affairs (RMA)¹ as well as how those innovations are recognized and implemented in the military (in this instance the Navy). It should have some value to students of national security because, as James Lacy writes, "A page of history . . . is worth a volume of logic."² This may be particularly true for military-technical history since, as Martin Van Creveld insists, "war is completely permeated by technology and governed by it."³

Van Creveld's study raises the intriguing possibility that a series of RMAs actually identifies "a single unifying theme" which dominates periods of warfare rather than a single revolution.⁴ He refers to these periods as "ages" and identifies them as:⁵

- » The Age of Tools (earliest times to 1500 A.D.)
 - » The Age of Machines (1500-1830)
-

¹ RMA is the latest jargon for the phenomenon previously referred to as Military-Technical Revolutions (MTR). According to Andrew Krepinevich, "The idea of a 'military-technical revolution' comes from Russian military writings of the 1980s." Andrew F. Krepinevich, Jr., *The Military-Technical Revolution: A Preliminary Assessment* (Washington, D.C.: Office of Secretary of Defense (Net Assessment), July 1992), p. 3.

² James Lacy, *Within Bounds: The Navy in Postwar American Security Policy* (Alexandria: Center for Naval Analyses, July 1983), p. i.

³ Martin Van Creveld, *Technology and War* (New York: The Free Press, 1991).

⁴ Unlike political revolutions, revolutions in military affairs are not flashpoints in history but are long-term in nature (i.e., more evolutionary than revolutionary, but the cumulative effects of adopted technical, doctrinal and organizational innovations are indeed revolutionary).

⁵ Van Creveld recognizes that his framework is somewhat "arbitrary" since "considerable overlap exists . . . the organization offered . . . is not intended to put history into straitjacket but simply to provide a framework for thought." Van Creveld, *op. cit.* in note 3, pp. 2-4.

- » The Age of Systems (1830-1945)
- » The Age of Automation (1945-present)

If Van Creveld's breakdown of history is indicative, we can expect that future revolutions will occur at an accelerated pace and future ages will be of decreasing duration. The current RMA could justifiably fall under Van Creveld's last age, but it could just as easily be the forerunner of a new period called the Age of Information. The cases examined in this study belong to the latest age whatever it is called and in some ways have helped usher it in.

Study Design

The works of several authors have been used to guide our research. Their hypotheses are the standards against which our results have been compared. The works of two of the authors, Vincent Davis and Stephen Rosen, in some ways, straddle that of a third author, Barry Posen. They provide three very different models of how innovation finds its way into the military. Because they all come from the academic community, a fourth author, Rear Admiral Ronald Kurth, USN (retired), was examined in order to provide an insider's look. He supports points made by the other authors but does not promote a new theoretical framework of his own. Finally, we have drawn heavily from Jeffrey Sands' insightful overview of organizational and innovation theory.⁶

This volume examines the dynamics of innovation in the Navy and tests conclusions, hypotheses and observations from these various studies. All of the authors used case studies as their basis; we do likewise. Davis' study examined the Navy's efforts to develop a capability to deliver nuclear weapons by carrier-bound aircraft; the development of nuclear propulsion units; the development of fleet ballistic missiles; and several pre-Second World War cases. Posen analyzed innovation in military strategy focusing on France, Britain and Germany between the First and Second World Wars. Rosen examined military innovation during approximately the same period looking at the British Army, the US Navy's submarine fleet and the US Army Air Corps' strategic bombing force. Kurth covers much of the same territory as Davis (i.e., the development of nuclear-powered submarines and fleet ballistic missiles).

⁶ Jeffrey I. Sands, "Sea Changes: Institutionalizing Innovation in Post-WWII U.S. Naval Strategy," (unpublished paper, 1994).

Two weapons systems suggested themselves for this study: Tomahawk cruise missiles and Aegis weapons system technology. Both of these systems have been successfully incorporated into the fleet and represent important technological advances in naval warfare. Both have also spurred significant doctrinal changes.

Military Innovation

Since the central theme of this study is innovation, defining in general terms what is meant by innovation is necessary. Stephen Rosen defines a *major innovation* as:

... a change that forces one of the primary combat arms of a service to change its concepts of operation and its relation to other combat arms, and to abandon or downgrade traditional missions. Such innovations involve a new way of war, with new ideas of how the components of the organization relate to each other and to the enemy, and new operational procedures conforming to those ideas. They involve changes in the critical military tasks, the tasks around which warplans revolve.

Rosen admits that his doctrinal definition excludes the types of advances in technology analyzed in Vincent Davis' work.⁸ But as Sam Gardiner has noted, "The essence of just about everyone's definition of a military-technical revolution points to the coming together of two components: technology and doctrine. It is not just technology. That's the reason it's called 'technical' and not 'technological.' It's the marriage of technology and doctrine, with doctrine representing a collective understanding of employment."⁹ In other words, both Davis' technology innovations and Rosen's doctrinal innovations are necessary elements for a revolution in military affairs. The two are inextricably connected and arguing which comes first, or which is

7 Stephen Peter Rosen, "New Ways of War: Understanding Military Innovation," *International Security*, Summer 1988, p. 134 (hereafter referred to as "New Ways"). Also see Rosen's more expansive study entitled, *Winning the Next War: Innovation and the Modern Military* (Ithaca: Cornell University Press, 1991) hereafter referred to as *Winning*.

8 Vincent Davis, *The Politics of Innovation: Patterns in Navy Cases*, Monograph Series in World Affairs, Vol. 4, No. 3 (Denver: University of Denver, 1967).

9 Sam Gardiner, "The Military-Technical Revolution: More Than Military and More Than Technical," *RSAS Newsletter*, Vol. 4, No. 3, August 1992, p. 9. Later, Gardiner adds that MTR "must mean bringing together technology, doctrine, and policy objectives. . . . We need to think in terms of the way military force will be used, against whom and for what purpose. . . . It is not a spontaneous revolution. It can be shaped. It must be shaped." (pp. 10-11).

more important, can only result in a "chicken and egg" debate. Andrew Ross avoided this debate by defining military technology in such a way that it encompasses both hardware and software. Military Technology, he writes, "includes not only the actual instruments or artifacts of warfare, but the means by which they are designed, developed, tested, produced, and supplied—as well as the organizational capabilities and processes by which hardware is absorbed and employed."¹⁰ This definition avoids the tendency of many analysts to focus on hardware rather than on organization and doctrine; it also overcomes the restrictions associated with Rosen's doctrinal definition.

Posen concludes that innovation comes from outside the military through the intervention of civilian authorities (often assisted by military mavericks); Rosen asserts it comes from within the military through the top down influence of senior military leaders; and Davis believes it comes from within the military through the persistent efforts of mid-grade officers. Kurth recognizes that sources of innovation vary but concludes that "it is unlikely that routine management will ever accomplish an innovative departure."¹¹ Direct comparison of these competing theories of innovation is difficult since Rosen and Posen look primarily at doctrinal innovation and Davis focuses on technological (hardware) innovation. A quick look at some of Posen's observations easily demonstrates the problem. In his examination of the British Royal Air Force and the French and German Armies, Posen saw "very little internally generated innovation in the three cases examined. The military organizations seem not to like innovation."¹² Where Posen did find innovation, notably in a new British air defense system and the German *Blitzkrieg* doctrine, it occurred only with the help of civilian intervention.¹³ On the other hand, Posen concludes

¹⁰ Andrew L. Ross, "The Dynamics of Military Technology," in David Dewitt, David Haglund and John Kirton, eds., *Building a New Global Order: Emerging Trends in International Security* (Oxford: Oxford University Press, 1993), p. 111.

¹¹ Ronald James Kurth, *The Politics of Technological Innovation in the United States Navy*, doctoral thesis (Cambridge, MA: Harvard University, June 1970).

¹² Barry R. Posen, *The Sources of Military Doctrine: France, Britain, and Germany between the World Wars* (Ithaca: Cornell University Press, 1984), p. 224. Posen does not specifically define innovation but does note "innovation must be judged in terms of the general military and technological environment." (p. 29) His study, however, does not focus on technological innovation and thus comparing his theories on doctrinal innovation to Davis' theories on technology innovation risks comparing apples to oranges.

¹³ Sands, on the other hand, concludes from his case studies that strategic innovation in the Navy is generated from within (*op. cit.* in note 6).

that "technological opportunities" are the realm of soldiers, who "must identify which ones are worth exploring, and at what rate."¹⁴ In other words, Posen believes that doctrinal innovation is imposed on the military while technological innovation must be pushed from the inside. This observation may help explain why Rosen insists that a "new theory of victory" must precede innovation and Davis does not—their positions are not necessarily mutually exclusive. The difference between Posen and Rosen, as noted earlier, is that Posen believes the source of doctrinal innovation is outside the military while Rosen believes it comes from within. Posen writes, "As a rule, soldiers are not going to go out of their way to reconcile the means they employ with the ends of state policy."¹⁵

All three hypotheses strongly rely on organization theory because, as stated by Posen, "organization theory seems to provide a good explanation for the operational preferences and behavior of military organizations."¹⁶ But as this study will show, individuals, not organizations, are the innovators. The desire to institutionalize innovation is really the pursuit of methods to encourage and accommodate innovators in a bureaucracy.

As pointed out in the introduction, technical innovation without doctrinal innovation cannot spark an RMA. Anthony Cordesman points out, "He who dies with the most toys simply dies, he does not win. Technology will only be valuable to the extent it is integrated into an effective overall force structure."¹⁷

Cordesman offers eight "iron laws" which must be followed if technological innovation is to have real world military value:

- [Implementation of] an effective concept of operations for employing the technology on a force-wide basis, and in effective combined arms and combined operations;
- Proper training both in operating the individual technology and integrating it into full scale combat operations.

¹⁴ Posen, *op. cit.* in note 12, p. 30.

¹⁵ *Ibid.*, p. 53.

¹⁶ *Ibid.*, p. 222.

¹⁷ Anthony Cordesman, "Compensating for Smaller Forces: Adjusting Ways and Means Through Technology," *Strategy and Technology* (Carlisle Barracks: Strategic Studies Institute, April 1, 1992), p. 8.

- Funding effective munitions for sustainability in combat, and the necessary command, control, communications, intelligence and battle management (C³I/BM), targeting and damage assessment assets.
- Suitable power projection, logistic, service support, and combat support capability.
- Suitable maintenance, repair, and recovery capability for the specific contingency where the technology is to be employed.
- Immunity to cost-effective countermeasures, and unexpected obsolescence within the required service life of the technology.
- Adequate skilled manpower to use the technology from the operator to the high command level.
- Reorganization, retraining, and adjustment of the concept of operations, technology mix, and force mix to suit the specific contingency, threat, and allied forces.¹⁸

While all this hints at a certain orderliness to technological innovation, Professor Edward Teller probably hit closer to the mark when he said, "Technological change is unpredictable. This is an absolute golden rule in modern strategy."¹⁹ This means, if true, that those attempting to integrate technological innovations into the military will always be playing "catch up." Nevertheless, hope springs eternal and there are those who not only believe they can, but must, get ahead of the game by asserting that the force "which does not keep its doctrine ahead of its equipment, and its vision far into the future, can only delude the nation into a false sense of security."²⁰

An Overview of Organization and Innovation Theory

As noted earlier, this section draws heavily on the insights of Jeffrey Sands. He notes that the current literature on organization and innovation suggest that efforts to institutionalize major innovations face an uphill battle for several reasons, which include:

¹⁸ *Ibid.*, pp. 8-9.

¹⁹ Quoted in Lacy, *op. cit.* in note 2, p. 33.

²⁰ General Henry H. (Hap) Arnold quoted in Air Force Manual 1-1, *Functions and Basic Doctrine of the United States Air Force*, February 1979, 4-11, cited in Kenneth P. Werrell, *The Evolution of the Cruise Missile* (Maxwell AFB: Air University Press, 1985), p. 1.

- » organizations abhor uncertainty, preferring predictability and stability.²¹
- » they are not self-evaluating and therefore cannot measure success.²²
- » top leaders of an organization are rarely presented with fresh and provocative arguments that might challenge their shared images.²³

In addition, military services are large, functionally specialized, conservative and hierarchical organizations, "caricatures of the archetypal bureaucracy." Thus, they are particularly resistant to major innovation.²⁴ The reasons for this resistance comes from the fact that:²⁵

- » the free flow of information is restricted in hierarchical organizations;
- » leaders have no interest in encouraging their own obsolescence by introducing innovation;
- » organizations such as the Navy, which are infrastructure intensive and where changes to that infrastructure are both expensive and lengthy, need some modicum of stability.

All this suggests that one should rarely find innovation in the military; yet, the Services, and especially the Navy, have a rather long history

²¹ Sands notes that, "Organization theory suggests that people employ search routines to generate and select alternative solutions. These alternatives are largely determined by courses of action already in an organization's repertoire." (*Op. cit.* in note 6, p. 5 n12. See also, J.G. March and H.A. Simon, *Organizations* (New York: John Wiley & Sons, 1958), especially pp. 136-50; and R.M. Cyert and J.G. March, *A Behavioral Theory of the Firm* (Englewood Cliffs, NJ: Prentice Hall, 1963), pp. 101-27).

²² Sands notes that "some bureaucracies have no direct way of evaluating the performance of personnel relative to critical tasks. Wilson suggests that such 'procedural organizations'—of which the peacetime military is a prime example—manage on the basis of process (e.g., professionalism) rather than outcome." (*Op. cit.* in note 6, p. 6; see also J.Q. Wilson, *Bureaucracy: What Government Agencies Do and Why They Do It* (New York: Basic Books, Inc., 1989), p. 163, and A. Wildavsky, "The Self-Evaluating Organization," *Public Administration Review*, 32 (September/October 1972), pp. 295-365.

²³ See Morton H. Halperin, *Bureaucratic Politics and Foreign Policy* (Washington, DC: Brookings Institution, 1974) pp. 151-3.

²⁴ Sands notes that the Navy has suffered from a particularly severe reputation for obstinacy as "illustrated by two famous quotes. In the first, Franklin Roosevelt is quoted as decrying the Navy's ability to defy his efforts to get the action and results he wanted: 'To change anything in the Na-a-vy is like punching a feather bed. You punch it with your right and you punch it with your left until your are finally exhausted, and then you find the damn bed just as it was before you started punching.' The second, by Henry Stimson, is a more general condemnation of 'peculiar psychology of the Navy Department, which frequently seemed to retire from the realm of logic into a dim religious world in which Neptune was God, Mahan his prophet, and the United States Navy the only true Church.'" (*Op. cit.* in note 6, p. 6)

²⁵ See Posen, *op. cit.* in note 12, pp. 44-6, 224.

of innovation in technology, doctrine and strategy. As Sands remarks, a variety of explanations are available for this phenomenon. Some of the factors are external to the organizations and some factors are internal.

External Factors: Innovation Imposed from the Outside

Stressing organization theory, Posen asserted that organizations innovate for three reasons: first, as the result of failure; second, when they are pressured from outside (e.g., customer dissatisfaction); and, third, when they desire to expand. Based on these causes, Posen poses three hypotheses concerning innovation in the military:²⁶

1. Because of the process of institutionalization, innovation in military doctrine should be rare.
2. Innovations in military doctrine will be rare because they increase operational uncertainty.
3. Because of obstacles to innovation discussed above, a technology that has not been tested in war can seldom function by itself as the catalyst for doctrinal innovation.

Posen claims there are two exceptions to the hypothesis concerning innovation in response to new technology:

4. Military organizations do seem willing to learn from wars fought by their client states—with weapons and perhaps the doctrine of their patron.
5. Military organizations are even better able to learn about technology by using it in their own wars.

Organization theory, Posen asserts, predicts two stronger and more reliable causes of innovation:

6. Military organizations innovate when they have failed—suffered a defeat.
7. Military organizations innovate when civilians intervene from without.

“None of this is to say,” Posen caveats, “that innovation in military doctrine is impossible. These are merely tendencies. Innovation is possible.”²⁷

Sands records that others support Posen’s position and asserts that civilian intervention is even more effective when it is combined

²⁶ *Ibid.*, pp. 54-7.

²⁷ *Ibid.*, p. 57.

... through alliances with military mavericks. . . . By analogy, therefore, mavericks could enter into alliance with civilians to institutionalize self-generated innovation attempts. Elting E. Morison illustrates this in his study of technological innovations in the U.S. Navy at the turn of the century. His study suggests that only external intervention (by the President) was able to break through the resistance encountered from the Navy bureaucracy. Eugene Lewis suggests that innovation requires a public entrepreneur who obtains sufficient autonomy and flexibility. Such entrepreneurs create apolitical shields by spanning organizational boundaries to protect or buffer the innovation. Hence, he also points to external factors, though they operate in a less direct fashion.²⁸

Internal Factors: Innovation Imposed from the Top Down

Rosen discounts the causal power of factors external to the organization as well as the role of mavericks. He claims four themes dealing with the problem of military innovation emerged from his studies:

First, innovation requires "a new theory of victory" which results in an ideological struggle within a particular Service.

Second, emerging from this ideological struggle must be new, concrete and critical tasks. "Without that reformulation and development of new critical tasks, new pieces of hardware or new ideas might drop into the service without affecting actual behavior."²⁹

Third, a new distribution of power within the Service must emerge from the ideological struggle as well as new paths to power (Flag rank).

Fourth, these new career paths are created from within, by senior officers currently holding power, rather than being forced upon the Service from outside.

In his overview of organization and innovation theory, Sands shows that Rosen also finds support from others. Morton Halperin introduces the notion of "organizational essence"—the view held by the dominant group in the organization of what the missions and capabilities of the organization should be—and suggests that organizations prefer autonomy even over resources. As Sands paraphrases the argument, "When the costs in autonomy resulting from the current

²⁸Sands, *op. cit.* in note 6, pp. 7-8 (see also, E.E. Morison, "A Case Study of Innovation," *Engineering and Science Magazine*, April 1950; E. Lewis, *Public Entrepreneurship: Toward a Theory of Bureaucratic Political Power* (Bloomington, IN: Indiana University Press, 1980), and Davis, *op. cit.* in note 8).

²⁹Rosen, "New Ways," *op. cit.* in note 7, p. 142.

view of the organizational essence are high, attempting a major innovation is better than doing nothing."³⁰

Innovation Developed from the Mid-grades Up

Davis' hypotheses range from agreement to diametric disagreement with Rosen's. Davis concluded from his research, for example, that technological innovations are not generally driven by either a new or a grand strategy, but reflect the belief that the innovation represents a better way of doing a mission already inherent in the Navy or an established national strategy.

Davis' study also suggests that innovation in the Navy does not come from the top but comes from the personal initiative of middle grade officers (O-4 to O-6). These innovators share several characteristics. They generally: recognize, rather than invent, innovations; possess unique technical expertise in the area of innovation; form informal horizontal working alliances to promote the innovation; and eventually gain vertical support from influential senior officers, who themselves may form informal horizontal working alliances. Thus, Davis' model predicts that most innovation will come from within the Navy. Davis refers to these innovators as passionate zealots.

Organizational Characteristics and Innovation

Matthew Evangelista identifies five structural characteristics that organization theorists suggest affect institutional innovation. These are:³¹

- » *Centralization* of power and control.
- » *Complexity* of the knowledge and expertise that the organization's members possess.
- » *Formalization* of the rules and procedures the organization imposes for its members to follow.
- » *Interconnectiveness*, the degree to which the organization can disseminate new ideas through interpersonal networks.
- » *Organizational slack*, the degree to which uncommitted resources are available.³²

³⁰ Sands, *op. cit.*, in note 6. See also Halperin, *op. cit.* in note 23.

³¹ See M. Evangelista, *Innovation and the Arms Race: How the United States and the Soviet Union Develop New Military Technologies* (Ithaca: Cornell University Press, 1988), pp. 28-49.

³² Rosen suggests that resource levels and innovation have no necessary connection, noting that innovation occurs in periods of growing or constrained resources. See Rosen, *Winning*, *op. cit.* in note 7, p. 252.

Sands analyzes the reported effects of these characteristics on organizational innovation with respect to the US weapons research and development process and the US Navy (Table 1).

Table 1. Organizational characteristics and Innovation³³

Characteristic	Effect on US		Effect on Idea	
	R&D	NAVY	Generation	Implementation
<i>Centralization</i>	Low	High	Inhibits	Encourages
<i>Complexity</i>	High	High	Encourages	Inhibits
<i>Formalization</i>	Low	High	Inhibits	Encourages
<i>Interconnectedness</i>	High	Varies	Encourages	Encourages
<i>Organizational slack</i>	High	Varies	Encourages	Encourages

These apparently disparate hypotheses suggest that innovation is essential but not as easy as most people believe. Adding to the difficulty is the fact that the US Navy remains the preeminent navy in the world. As Andrew Marshall noted, "When you dominate the landscape, you need to keep innovation strong. But it's hard to innovate when you dominate the landscape."³⁴ In other words, those in leadership positions generally think they are doing a good, innovative job and only discover otherwise when it is too late. Perhaps this observation should not be a surprise since, as Lacy concluded, it is nearly impossible to generate grand strategy. He explained:

Military intellectuals, policy analysts, and military scientists were simply not capable—certainly not after the late 1950s [as the U.S. was moving beyond the policy of massive retaliation]—of generating the "one right grand strategy" from which derivative policies could be deduced with confidence and against which competing contentions about functions and missions could be weighed and determined. Strategy was more a series of issues than a set of cogent answers.³⁵

This point bears heavily on the question of what is "innovation." The US is embarking on an era in which it must plan for regional conflicts rather than global war. Since each region requires a different strategy, assumes different coalition partners and may require a different mix of forces, implementation of technical innovation would be doomed

³³Sands, *op. cit.* in note 6, p. 10.

³⁴Meeting with Andrew Marshall and Andrew Krepinevich at the Naval War College, 18 November 1992.

³⁵Lacy, *op. cit.* in note 2, p. 556.

if its success relied on association to a grand strategy. On the other hand, Davis argues persuasively that in the case of nuclear submarines and fleet ballistic missiles, that technology was the driver behind the development of new strategy. As forces get smaller and national leadership places greater stress on high technology, this may become a common pattern in the future.³⁶ Glenn Snyder noted this was the case in the early Eisenhower years, when "the formulation of the policy did not run from statements of 'policy objectives,' to 'strategy,' to 'capabilities,' but the other way around."³⁷

Technological Innovation and the Navy

Although technical innovation is vital to all military Services, innovation appears particularly critical for navies. Colin Gray and Roger Barnett have asserted, "In its very nature, naval warfare is high-technology warfare: Moreover, this has always been true. A great naval historian has observed that: 'An ocean-going ship, with her masts and sails, was incomparably the most elaborate mechanism which the mind of man had yet developed.'"³⁸

Supporting this theme, Karl Lautenschläger noted that, "Naval warfare in general is sensitive to changes in technology, because it is platform as well as weapons that are necessary for combat at sea. Whereas armies have historically armed and supported the man, navies have essentially manned and supported the arm."³⁹ Current naval leadership apparently accepts this premise since its favored option for structuring the post-Cold War Navy protects force structure while drastically reducing personnel end-strength.⁴⁰ Under this option, major savings would be made by

³⁶Former Secretary of Defense Les Aspin, for example, often stressed the value of high technology weapons, noting that in Iraq "the high technology systems were at the heart of that successful enterprise." (Address at the Armed Forces welcoming ceremony at Fort Myer, VA, on 1 February 1993.)

³⁷Glenn H. Snyder, "The 'New Look' of 1953," in Warner R. Schilling, Paul Y. Hammond and Glenn H. Snyder, eds., *Strategy, Politics, and Defense Budgets* (1962), p. 498. (Quoted in Lacy, p. 34).

³⁸Colin S. Gray and Roger W. Barnett, *Seapower and Strategy* (Annapolis: Naval Institute Press, 1989), p. 379, quoting Laird G. Clowes.

³⁹Karl Lautenschläger, "Technology and the Evolution of Naval Warfare," *International Security*, Vol. 8, No. 2, Fall 1983, p. 5.

⁴⁰Gregory Vistica, "Navy weighs major new cuts," *San Diego Union-Tribune*, 1 February 1993, p. 1.

reducing personnel from 585,000 in 1992 to 375,000 in 1999. This reduction would be complemented by the retirement of 140 older ships.

Another reason innovation is critical to the Navy is because naval systems tend to have long service lives (i.e., between 20 and 50 years). Innovative adaption of these systems is essential if they are to remain relevant throughout their service lives.⁴¹ Since innovation is vital to the Navy, understanding the process through which innovation is implemented in the Navy is also critical. One would think that an organization which appears so dependent on adapting technological advances would have an institutionalized approach to innovation. But Earl Cooper and Steven Shaker argue that the Navy has only recently emphasized "technology push" as the basis for innovative advances in naval hardware.⁴²

Perhaps this lack of emphasis can be blamed on the aperiodic and unpredictable nature of innovation. Karl Lautenschläger concluded that a single, "new technology has not revolutionized naval warfare. . . . It was the final integration of several technologies. . . . In looking to the future . . . it should prove . . . useful to examine combinations of existing technologies. Their effects will be felt first, probably in one of three ways. These are: 1) synthesis—new combinations of existing technologies, 2) a keystone—a missing link for a new ensemble of technologies, or 3) tactical innovation—new uses for existing forces."⁴³ Our study tends to confirm this observation.

Innovation and the Innovator

Davis applied behavioral science perspectives, through the filter of a political scientist, to explore the conduct of individuals in the US Navy in relation to the development of technological innovations in weapons systems. As a result, he developed several hypotheses concerning characteristics common to innovators and their tactics. The following Davis hypotheses, conclusions and observations will be tested in our case studies:

⁴¹Lacy notes that "naval forces in particular, given their long construction lead times, take a decade or more to substantially change character." (*Op. cit.* in note 2, p. 26.)

⁴²Earl D. Cooper and Steven M. Shaker, "The Military Forecasters," *The Futurist*, Vol. 22, No. 3, pp. 37-43.

⁴³Lautenschläger, *op. cit.* in note 39, p. 50.

1. *The innovation advocate in the Navy:*

- (a) Is usually an officer in the broad middle ranks.
- (b) Is seldom the inventor of the innovation he is promoting, but he usually possesses a uniquely advanced technological knowledge pertinent to the innovation that is not generally shared within the Navy.
- (c) Is a passionate zealot.
- (d) Seldom pays any attention to the way in which his crusading efforts may influence his personal career in the Navy or elsewhere.

2. *The advocate's political techniques include:*

- (a) Establishing a horizontal political alliance by enlisting supporters from among friends and colleagues at his own rank level.
- (b) Establishing a vertical political alliance by recruiting supporters in key positions of authority and power at higher levels.
- (c) Rejecting extra-organizational supporters or allies unless it appears necessary as a last resort.
- (d) Selling the innovation as a better way to perform some well-established Navy task or mission, rather than as a new military strategy, tactic or concept.

3. *The opponent's political techniques, if one emerges, include:*

- (a) Seeking lower rank level support since opposition normally emerges at senior rank levels.
- (b) Countering pro-innovation arguments on the grounds that "it will cost too much."
- (c) Arguing on the same grounds as the pro-alliance, i.e., insisting no need for a better way to perform well-established tasks or missions without reference to new concepts, strategies or tactics.

Davis pointed out that one of the major drawbacks to research of this kind is the inevitable labelling of "winners" and "losers" in the introduction of new systems, "winners" being those whose ideas were implemented and "losers" being their opponents. He found that:

"Losers" are difficult to identify because even their opponents within the Navy seem to join in a wall of silence to protect them from external scrutiny and perhaps publicity. And, when a loser occasionally can be located, he is usually

not interested in divulging very much to an interviewer. The inability to present losing cases means an inability to present rigorously comparative conclusions contrasting winners and winning strategies with losers and losing strategies. It is also impossible, for example, to say very much of a conclusive nature about the precise degree of career risk that an innovation advocate runs.⁴⁴

For those same reasons, Davis points out that finding cases in which innovation advocates lost is nearly impossible. We are not talking about heroes and villains. Paraphrasing lines from a popular song, there are no "good guys," there are no "bad guys," there's just people who honestly disagree. Unfortunately, as Davis points out, the winners are seen as intelligent and progressive while the losers are viewed as cautious, conservative and, even, reactionary.⁴⁵

Posen, even though he concludes that civilian "intervention is often responsible for the level of [doctrinal] innovation and integration achieved,"⁴⁶ also believes that "[c]ivilians do not necessarily have the expertise to directly change military doctrine in order to bring it into conformity with an overall grand strategic design. They must rely upon mavericks within military organizations for the details of doctrinal and operational innovation."⁴⁷ Kurth sides with Davis and Posen believing "[t]he role of innovator is a highly personalized endeavor. . . . So long as he produces results, leave him alone."⁴⁸ In the case studies that follow, one will find military zealots and mavericks as well as interventions by forceful civilian leaders.

The following two chapters examine the development and introduction of land-attack cruise missile and Aegis combat system technology into the Navy. They are followed by a chapter which draws lessons from these case studies as well as from the numerous interviews conducted during the course of our research. The final chapter provides a brief review of the conclusions reached during the study.

⁴⁴Davis, *op. cit.* in note 8, p. 4n2.

⁴⁵Davis also notes that "unless one assumes that all innovative proposals are equally sound and worthy, the opponents serve the valuable function of filtering out the less worthy and less sound ideas." *Ibid.*, p. 5n3.

⁴⁶Posen, *op. cit.* in note 12, p. 227.

⁴⁷Posen, *op. cit.* in note 12, pp. 174-175.

⁴⁸Kurth, *op. cit.* in note 11, p. 388.

Chapter 2

CRUISE MISSILES AND THE TOMAHAWK

Gregory A. Engel

This chapter explores the origins of the modern cruise missile and the ultimate development of the Tomahawk cruise missile, particularly the conventional variant. In keeping with the theme of the study, it focuses on the politics of cruise missile development and the implications as they relate to a Revolution in Military Affairs.

The full history of cruise missiles can be traced to the development of the V-1 "buzz bomb" used in the Second World War. Since this history is available in many publications, it will not be discussed here nor is it especially pertinent to modern cruise missile development. Worth noting, however, is that the enthusiasm of many early Harpoon and Tomahawk advocates can be linked to the Regulus and other unmanned aircraft programs of the 1950s and 1960s.

What this chapter will show is that although air- and sea-launched cruise missiles (ALCM/SLCM) began along different paths neither would have come to full production and operation had it not been for intervention from the highest civilian levels. Having support from the top, however, did not mean there were not currents, cross currents and eddies below the surface (i.e., at the senior and middle military levels) stirring up the political water. Studying the challenges faced by cruise missile advocates and how they were overcome can provide valuable lessons for those tasked with developing tomorrow's technological innovations.

The development of the modern cruise missile spanned nearly fifteen years from conception to initial operational capability (IOC). To those introduced to the cruise missile on CNN during the Gulf crisis in 1991, however, the modern cruise missile seemed more like an overnight leap from science fiction to reality. But as this chapter will show, both cruise missile technology and doctrinal adaptations were slow to be accepted.

Since SLCM and ALCM were managed independently before merging in 1977, their separate lineages will be described. Although both missiles emerged from strategic concerns, the sea-launched cruise missile can also trace its roots to the requirement for a tactical antiship missile, the Harpoon.

Sea-Launched Cruise Missile

The political and bureaucratic roads to acceptance of the sea-launched cruise missile were never smooth. As Ronald Huisken noted, "The weapons acquisition process is a most complex amalgam of political, military, technological, economic, and bureaucratic considerations. . . . Rational behavior in this field is particularly hard to define and even harder to enforce."¹ Since they first became feasible, the Navy demonstrated an interest in cruise missiles. But finding a champion for them among the Navy's three primary warfighting "unions" (associated with carrier aviation, submarines and surface warfare) proved difficult. Despite the cancellation of the Regulus program in the 1960s, some surface warfighters aspired to develop an antiship cruise missile which could compete with evolving Soviet technologies. But carrier aviation was the centerpiece of naval war at sea, so initially, little support could be garnered for a new variety of surface-to-surface missile. As the requirement for an antiship missile became more evident following the 1962 Cuban missile crisis, surface-to-air missiles (SAMs) were given some surface-to-surface capability.²

However, following the 1967 sinking of the Israeli destroyer *Elath* by an Egyptian SSN-2 Styx missile, Admiral Elmo "Bud" Zumwalt, Jr., then a Rear Admiral and head of the Systems Analysis Division, was directed by Paul Nitze, the Secretary of the Navy, via Admiral Thomas Moorer, the Chief of Naval Operations, to initiate a study on cruise missiles that eventually led to the Harpoon.

When Nitze directed the Navy to undertake the study on surface-to-surface missiles, there were two prevailing military requirements. The first was that the US needed such a capability to counter the growing strategic potential of the Soviets. The second was to improve the US's strategic balance. During this period, there was growing alarm over

¹ Ronald Huisken, *The Origin of the Strategic Cruise Missile* (New York: Praeger Publishers, 1981), p. xiii.

² Interview with Rear Admiral Walter M. Locke, USN, (Ret.), McLean, VA, 5 May 1993.

the rapidly expanding Soviet nuclear missile arsenal and the naval ship building race which (to some) the Soviets appeared to be winning. Admiral Zumwalt was one of those concerned individuals and saw the cruise missile as a required capability. He brought this conviction with him when he became the Chief of Naval Operations in July 1970.³

Naval doctrine at this time held that US surface vessels did not need long-range surface-to-surface capabilities as long as carrier aviation could provide them.⁴ Many in Congress shared this view. Against this backdrop, Zumwalt and other like-minded advocates of cruise missiles began their efforts to gain acceptance of cruise missiles within the Navy and on the Hill.

Following over two years of study and tests, a November 1970 meeting of the Defense Select Acquisition Review Council (DSARC) approved the development of the AGM-84 Harpoon missile. By this time, the Harpoon had both sea- and air-launched variants. Within the Navy, the Harpoon had been bureaucratically opposed by the carrier community because it posed a threat to naval aviation missions. During the Vietnam War period, the carrier union was a major benefactor of naval defense funding and it did not want to support any weapons system which could hinder or compete with aircraft or carrier acquisition programs. In order to gain their support, the Harpoon was technologically limited in range.⁵

The Harpoon project had been under the direction of Navy Captain Claude P. "Bud" Ekas with Commander Walter Locke serving as his guidance project officer. Both officers were later promoted to Rear Admiral. In 1971, the Navy began studying a third Harpoon variant, one which could be launched from submarine torpedo tubes. Concurrently, the Navy began a program to study the Advanced Cruise Missile (ACM). This advanced model was to have an extended range of over 300 miles and to be launched from vertical launch tubes.⁶ This proposal was generally supported by the submarine community (the criticality of this support will be discussed later).

³ Interview with Admiral Elmo R. Zumwalt, Jr., USN (Ret.), former Chief of Naval Operations, Washington, D.C., 28 May 1993.

⁴ Richard K. Betts, ed., *Cruise Missiles: Technology, Strategy, Politics* (Washington, D.C.: The Brookings Institution, 1981), p. 380. ADM Zumwalt's predecessor, ADM Moorer, chose to respond to the *Elath* incident by enhancing the capabilities of the carrier fleet, not those of the surface fleet. (*Ibid.*, p. 384).

⁵ Zumwalt interview, 28 May 1993.

⁶ Betts, *op. cit.* in note 4, p. 84.

With the advent of the ACM, it was decided to create the advanced cruise missile project office with Locke as director. The Naval Ordnance Systems Command (NAVORD) wanted control of the ACM project and argued that it was the appropriate parent organization for submarine launched missiles. Admiral Hyman Rickover and other OPNAV submarine admirals opposed this believing that Naval Air Systems Command (NAVAIR) was more imaginative and efficient than NAVORD. The earlier assignment of the ship- and air-launched Harpoon to NAVAIR had effectively co-opted the technical leadership of naval aviation. As a result, the ACM program remained under NAVAIR where work proceeded rapidly.⁷

During this period, Dr. John Foster, Director of Defense Research and Engineering (DDR&E), was one of the sea-launched cruise missile's key supporters in 1971 and '72 and earlier reawakened interest in an air-launched cruise missile.⁸ Over the period from about 1968 to 1972 when the first strategic cruise missile was proposed, technological developments made compact, long-range, low altitude, highly accurate cruise missiles a distinct possibility.⁹ The growing consensus was that this was a weapon of high capability which could be obtained at comparatively low development cost. Tactically, the naval strategic cruise missile, the Regulus, had no roles because, as Foster testified to Congress in 1971, potential enemies provided no targets (i.e., the Soviet fleet of the early 1960s).¹⁰ Nevertheless, Foster believed that cruise missiles deployed on submarines "would add more deterrent per dollar than any other of our schemes."¹¹ He noted that the SLCM did not have the basing vulnerability of the ICBM and that it had a special advantage over the mobile ICBM then being considered because of its unique flight profile and smaller launch signature. Congressional funding was therefore predicated on the cruise missile's strategic significance.

The strategic implications of the SLCM were first realized in 1971 as Secretary of Defense Melvin R. Laird began to prepare for Strategic Arms Limitation Treaty (SALT I) negotiations. In searching for weapon

⁷ Locke interview, 5 May 1993.

⁸ *Ibid.*

⁹ Huisken, *op. cit.* in note 1, p. 171.

¹⁰ *Ibid.*, p. 21.

¹¹ *Ibid.*, p. 35.

systems which could be used to strengthen the US position, Dr. Foster suggested to Laird that by combining emerging technologies (improved turbofan engines, integrated circuits, and terrain contour mapping) with existing cruise missile airframes a new strategic weapon could be fielded.¹² Whether or not this idea was accepted on its own merit or as a bargaining chip for use during the SALT negotiations is not clear.¹³ What is clear is that Laird decided the SLCM was worthy of further study and development. The SALT I agreement was signed by the US and the Soviet Union in May 1972 and in June Secretary Laird unexpectedly requested \$20 million to initiate a vaguely defined strategic cruise missile program.¹⁴ Although Congress reduced this amount to \$4 million, and only \$2.59 million the following year, the program focused the Navy on the SLCM which had been largely ignored to that point. "Restated from a different perspective, the strategic [cruise] missile in 1972 was a weapon whose time had come."¹⁵

In the early 1970s, several Center for Naval Analyses studies furnished to ADM Zumwalt supported a broader strategic role for the cruise missile as part of his naval enhancement program, *Project 60*.¹⁶ The traditional strategic triad of ICBMs, bombers and SLBMs could be countered to various degrees by Soviet ICBMs, ballistic missile defense systems (BMDS), air defense systems, and antisubmarine warfare (ASW) efforts. What the SLCM brought to the table was increased strategic diversification.¹⁷

The US technological lead over the Soviets was perceived as dwindling and, as such, added stubborn resolve to the Soviets at the strategic negotiating table. As Kissinger related in an interview in 1979, the cruise missile added the hedge that, when the five-year

¹²Interview with Dr. John Foster, former Director of Defense Research and Engineering, Redondo Beach, CA, 20 September 1993 and Rear Admiral David R. Oliver, USN, Office of the Chief of Naval Operations - N80, Washington, D.C., 10 August 1993. Secretary Laird had first heard of cruise missile technology while serving on the House Appropriations Committee.

¹³In hearings for the *Fiscal Year 1974 Authorization for Military Procurement* a Defense Department official indicated that the US and USSR in SALT I discussed cruise missiles of intercontinental range.

¹⁴Huisken, *op. cit.* in note 1, pp. 31 & 33.

¹⁵*Ibid.*, p. 171.

¹⁶Interview with Dr. Andy Borden, Center for Naval Analyses, Alexandria, VA, 13 July 1993.

¹⁷*Ibid.*

interim agreement on offensive weapons expired, the United States would be in a position to catch up quantitatively or at least present a credible image of being able to do so.¹⁸ This logic was questioned by some members of Congress who wondered why, if one or more legs of the strategic triad were no longer relevant, they were still being funded? If they still were relevant, why add a fourth leg? Maintaining a technological edge over the Soviets by developing and fielding a state-of-the-art weapons system was the eventual answer.

The ACM program of 1971, which barely lasted two years, was significant in that it formed the political, fiscal and technological connection between the Harpoon and the Tomahawk. Long-range cruise missile advocates within the Navy were having difficulty promoting the larger submarine-launched cruise missile because of the ACM's need for a new submarine. In 1973, they admitted they had no urgent military requirement for a long-range tactical (antiship) variant of the SLCM, but they justified it as a bargain with small added cost to strategic cruise missile development. SLCM represented a technological advancement of untold potential that begged for a home. Congressional and OSD acceptance of the ACM paid the bulk of the development costs of a tactical (antiship) variant of the SLCM.¹⁹ This all fit fortuitously into the time frame when SALT I negotiators were searching for strategic options.

By mid 1972, there was little support for the tactical nuclear variant of the ACM and the critics within the Navy were powerful. Thus Ekas and Locke worked to link the ACM development team with OSD strategic advocates. Funding and advocacy remained available within OSD for strategic versions of the SLCM. "It was thus only sensible to arrange a marriage of convenience. With Zumwalt's manipulation, Laird's intervention thus set the Navy on a nearly irreversible course. By 6 November 1972—the date of the consolidation order—surface fleet proponents of a new surface-to-surface missile had effectively won their battle, even if they did not realize it at the time."²⁰ In December 1972, a new program office, PMA-263, was established and Captain Locke was transferred from the Harpoon Program Office to become the Program Manager.²¹

¹⁸ Huiskens, *op. cit.* in note 1, p. 34.

¹⁹ *Ibid.*, p. 30.

²⁰ Kenneth P. Werrell, *The Evolution of the Cruise Missile* (Maxwell Air Force Base, AL: Air University Press, 1985), p. 387.

²¹ Ross R. Hatch, Joseph L. Lubner and James W. Walker, "Fifty Years of Strike Warfare Research at the Applied Physics Laboratory," *Johns Hopkins APL Technical Digest*, Vol. 13, No. 1 (1992), p. 117.

Admiral Locke has noted that others in the Navy Department did not believe in the cruise missile. He received a telephone call in June 1972 from an OPNAV staff Captain directing him to "do the right thing" with the recently allocated project funding, i.e., get the money "assigned to things doing work that we can use afterward." The implication was that the Pentagon had decided it was going to be a one year program and then was going away. Cruise missiles were seen as a SALT I bargaining chip that made Congressional hawks feel good.²² Not even all submariners were infatuated with the idea; but two submariners who did support it were Admiral Robert Long and Vice Admiral Joe Williams. Admiral Long, who was OP-02 (Deputy Chief of Naval Operations, Undersea Warfare), believed cruise missiles would do more than take up space for torpedoes—the most common complaint heard from submariners—and was its most influential advocate.²³ He was supported by Vice Admiral Williams, who was noted by Locke as also being important to the cruise missile program in the early 1970s.²⁴

Even though the Navy was moving ahead with its cruise missile program, as Foster recalls, the instigation for cruise missiles was the increasing vulnerability of the B-52 manned bomber force.²⁵ Foster and Laird knew they wanted the SLCM, but little else was decided beyond employment schemes for submarines. Submarines were considered the least vulnerable of all launch platforms. By autumn 1972, there were four combinations of submarines and launch modes:

(1) Cruise missiles vertically launched from converted nuclear ballistic missile submarines (SSBNs). Laird assumed this baseline. The Navy leadership opposed the conversions because of the high cost to refurbish these obsolete submarines.

(2) Cruise missiles horizontally launched from nuclear attack submarines (SSNs). Admiral Zumwalt's desire. Most technical experts did not think that a cruise missile capable of fitting into a torpedo tube could achieve a strategically effective range.

²² Locke interview, 5 May 1993.

²³ Interview with Vice Admiral James Doyle, USN, (Ret.), Bethesda, MD, 11 August 1993.

²⁴ Admiral Locke greatly credits their vision and assistance during the early formation years of the cruise missile. Locke interview, 14 July 1993.

²⁵ Foster interview, 20 September 1993.

(3) Cruise missiles horizontally launched from converted SSBNs. OSD staff compromise suggestion that combined all the problems of options 1 and 2.

(4) Cruise missiles vertically launched from a new class of SSN. Rickover's "new" submarine design which justified the Advanced Cruise Missile effort.

Within the Navy, other factors were at work. In 1968, Admiral Rickover started development of a 60,000 shaft horsepower (SHP) propulsion plant for a new tactical cruise missile submarine. He was having difficulty getting approval from the naval staff (OPNAV) to put this plant in a new class of submarine—one larger than the 688-class SSN. Rickover's ambition was to mate his power plant with a new submarine which could carry the Advanced Cruise Missile.²⁶ Dr. Foster was opposed to the submarine because of the money required. An additional obstacle was that, at this time, Undersea Warfare (as OP-31) came under the control of Surface Warfare, OP-03. Thus funding had to come from the surface community and support for a new submarine did not generate a great deal of enthusiasm.

Initial technical studies indicated that desired cruise missile ranges could not be obtained from a weapon designed to fit in a 21-inch torpedo tube; thus, the missile necessitated development of a new submarine fitted with 40-inch vertical launch tubes. Zumwalt, who understood this relationship, directed his Systems Analyses staff, OP-96, to argue against the submarine and criticize the cruise missile.²⁷ A curious position to be in as cruise missile advocates.²⁸ ADM Zumwalt was not prepared to concede the 60,000 SHP submarine to ADM Rickover for a variety of reasons, but primarily because it would decrement funding for other *Project 60* items. Submariners believed that getting approval for installing the newly envisioned encapsulated Harpoon would eventually lead to a newer, increased capability torpedo. Without ADM Zumwalt's knowledge, Joe Williams and Bud Ekas received approval from the Vice CNO, Admiral Cousins, to discretely prototype and test the encapsulated Harpoon. When advised of the results, ADM Zumwalt was chagrined that there was a possible submarine conspiracy underfoot but was eventually persuaded that the funding for further testing would be minimal (mainly for the canisters, tail sections and the test missiles). There

²⁶ Locke interview, 5 May 1993.

²⁷ *Ibid.*

²⁸ *Ibid.*

was also the possibility of SSNs carrying later versions of the Harpoon with greatly extended ranges which would allow strikes on the Soviet Navy when weather might preclude carrier aviation strikes in the northern latitudes.²⁹

Although ADM Zumwalt had relented, he remained wary of the submarine community's desire for a new, larger submarine. As program manager for SLCM, Admiral Locke found himself allied with the submariners in order to garner funding support for his missile. Zumwalt threatened to end procurement of the 688-class SSN if Rickover continued to pursue the 60,000 SHP submarine.³⁰ When wind tunnel tests, which had been directed by Locke, indicated that the required range could be obtained from a cruise missile which could fit in the 21-inch torpedo tube, Rickover and other submariners agreed to halt their quest for a larger attack submarine in exchange for continued procurement of the 688-class *and* continued development of the cruise missile soon to be known as the Tomahawk.³¹ Thus, the ACM project was quietly dropped in 1972, but the research on antiship cruise missiles continued as part of the SLCM program at Zumwalt's personal insistence.³² Following a January 1972 memo from the Secretary of Defense to the DDR&E which started a Strategic Cruise Missile program using FY 72 supplemental funds that were never appropriated, the CNO ordered that priority be given to the encapsulated Harpoon.³³

A fifth option eventually evolved and, as a result to Locke's persistent effort with the OSD and OPNAV staffs, was accepted. That option was to proceed with the development of a cruise missile with both *strategic and tactical* nuclear applications that would be compatible with all existing potential launch platforms. What this fifth

²⁹ Interview with Vice Admiral Joe Williams, USN, (Ret.), Groton, CT, 26 August 1993. The majority of the information in this paragraph is from this interview.

³⁰ *Ibid.*

³¹ Admiral Zumwalt acknowledged in his book that Rickover and carrier aviation were impediments to his *Project 60* plan throughout his tenure as CNO. [Elmo R. Zumwalt, Jr., *On Watch: A Memoir* (New York: Quadrangle, 1976)] His apparent lack of advocacy for cruise missiles should not be misinterpreted. He used cruise missiles as a bargaining chip to obtain his higher goal of a balanced Navy which he felt was necessary to counter the Soviet threat. His threats to prevent Harpoon/cruise missile employment was merely a counter to Rickover's "shenanigans," as he referred to them.

³² Betts, *op. cit.* in note 4, p. 386. The Soviets eventually fielded their own large cruise missile submarine, the Oscar-class.

³³ Werrell, *op. cit.* in note 20, p. 151 and Locke interview, 28 August 1994.

option really did was detach the missile's technical challenges from a specific launch platform so that missile development could progress independently of the submarine issue.³⁴

In 1973, Defense Secretary Laird was replaced by Eliot Richardson. Although Richardson stated he supported Laird's views on SLCM, his endorsement was neither as enthusiastic nor emphatic. He merely indicated that the United States should give some attention to this particular area of technology, for both strategic and tactical nuclear roles. Support from OSD did not wane, however, and was kicked into high gear by William P. Clements, the Deputy Secretary of Defense. President Nixon had handpicked Clements to assemble a team of acquisition experts from civilian industries to fill the OSD Under Secretaries positions.³⁵ Clements coordinated his efforts with Dr. Foster, who was still Director Defense Engineering and Research. All major defense projects were evaluated and those with the most promise were maintained or strengthened; those lacking promise were decreased or cancelled. He was also looking for programs that would give the US leverage, and when he learned about cruise missiles, he became a super advocate.³⁶ The cruise missile represented the cutting edge of new technology and held promise of a high payoff for low relative cost. It's fair to say that the US "wouldn't have had a cruise missile without Bill Clements grasping, conceptually, the idea and pushing the hell out it."³⁷

Before the 1975 defense budget was completed in late 1973, Richardson was replaced as Secretary of Defense by James Schlesinger, and Malcolm Currie became DDR&E. Schlesinger was not particularly excited about strategic cruise missiles but did formally commit the US to a strategic posture that included limited retaliation options against the USSR.³⁸ Currie, on the other hand, was almost as committed as Clements to ensuring cruise missile development proceeded. In his first report to Congress in April 1974, Currie reiterated that cruise missiles were a major alternative for penetrating

³⁴Locke interview, 5 May 1993. (Emphasis added)

³⁵Interview with the Honorable William P. Clements, former Deputy Secretary of Defense, Taos, NM, 16 June 1993.

³⁶Locke interview, 5 May 1993.

³⁷Interview with Dr. Malcolm Currie, former Director of Defense Research and Engineering, Van Nuys, CA, 21 September 1993.

³⁸Huiskens, *op. cit.* in note 1, p. 40.

Soviet air defenses. He also believed that SLCMs would complicate Soviet targeting because every US submarine would become a potential launch platform. He argued that any planned Soviet defense against them would be enormously expensive, but believed they would take up the challenge and divert resources from traditional offensive strategic capabilities.³⁹

In the first DSARC review of the program in February 1974, the issuance of competitive contracts was approved. The Navy selected General Dynamics and LTV for a competitive "fly-off" and announced that the final missile developer selection would be made early in 1976. A few months later, McDonnell Douglas and E-Systems were chosen for the guidance competition. The previous fall (1973), \$45 million had been included in the budget for the development of only the antiship nuclear version.⁴⁰ Clements, however, decided to proceed with both versions, fearing that if the strategic variant was dropped, there was substantial risk that Congress would feel justified in cancelling the entire program. He also doubted the Air Force's commitment to a strategic, air-launched cruise missile.⁴¹ Admiral Zumwalt cancelled the ACM in favor of a torpedo tube nuclear variant of the SLCM—a directive which OSD ignored. After the technical community was certain that a torpedo tube launched cruise missile could be successful, the operational requirement document on the sea-launched cruise missile was eventually detailed in November 1974.

Three years later in January 1977, the DSARC approved engineering development for all versions of the SLCM, now called the Tomahawk, and established the Joint Cruise Missile Project Office (JCMPO) with the Navy as the lead Service under the direction of Captain Locke. The JCMPO was given authority to administer all SLCM and ALCM efforts.

Mission Development. Before the promise of the cruise missile could be realized, two challenges had to be overcome—range and accuracy. How well these challenges were met determined, in large part, the missions cruise missiles were eventually assigned. Apart from a few studies, there was no hard evidence that a small airframe

³⁹ *Ibid.*, p. 41, extracted from *Department of Defense Appropriations for 1975* hearings, p. 580.

⁴⁰ Locke interview, 14 July 1993.

⁴¹ Huiskens, *op. cit.* in note 1, p. 39, with figures from *Fiscal Year 1975 Authorization for Military Procurement* hearings, p. 2472.

cruise missile could achieve the desired 1400 NM ranges or the required accuracy. Range relied on the efficiency of small turbofan engines. Although short-range engines had been demonstrated in the early 1960s, not until the next decade were engines developed with the power and fuel economy required. The second major and the most critical hurdle was guidance. Terrain contour mapping (TERCOM) was developed and patented in the late 1950s for missile programs which were later cancelled. Its developer, E-Systems, kept the idea alive and it was chosen by the Navy program office in 1972 as the most promising approach for the SLCM. Initial tests in 1973 showed that TERCOM-aided inertial navigation systems could more than meet accuracy needs—circular error probabilities (CEPs) on the order of 400 feet.⁴²

Another significant innovation was the evolution of a miniaturized warhead for other missiles which could give the required yield yet fit in a small airframe. Nuclear warheads were available from production; nevertheless, new warheads were developed because of more stringent safety requirements, and, perhaps to keep the nuclear laboratories busy.⁴³ All of this, combined with modern integrated circuits, meant that the United States could develop a cruise missile which hadn't been technologically feasible in the 1960s. The technical challenge and "breakthrough invention" was the fashioning of an economical missile system from the components. As Dr. Currie said, "Putting that [TERCOM] together with a small airframe was the genesis of the cruise missile from a technical point of view."⁴⁴ Once these capabilities were demonstrated, it was much easier to acquire support and funding for the program.

Despite these technological breakthroughs, by 1974 missions for the cruise missile were still vague. Congress wanted to know why the Navy would be putting a 1400 NM missile on submarines when, for years, they had been working to increase the distance from which they could launch attacks against the Soviet Union? They also wanted to know whether it was to be a strategic or tactical nuclear missile? The Air Force was still wary of a strategic SLCM because they didn't want further Navy encroachment on their strategic missions.⁴⁵ Congress

⁴²Betts, *op. cit.* in note 4, p. 88.

⁴³Locke interview, 28 August 1994.

⁴⁴Currie interview, 21 September 1993.

⁴⁵Interview with Bob Holsapple, former Public Affairs and Congressional Relations Officer for the Tomahawk program, Alexandria, VA, 27 May 1993.

had additional misgivings about what effect the cruise missile would have on strategic stability since the strategic and tactical variants were virtually indistinguishable. No one denied that the cruise missile exhibited great promise but it lacked a specified mission.

Although Foster's successor at DDR&E, Malcolm Currie, viewed cruise missiles as a major alternative for penetrating the formidable Soviet air defense system (the original reason for instigating cruise missile R&D),⁴⁶ he also saw the cruise missile, particularly the SLCM, as providing a valuable strategic reserve. "A sea-launched cruise missile development provides a desirable augmentation of capability, a unique potential for unambiguous, controlled single weapon response and an invulnerable reserve force."⁴⁷ In short, cruise missiles launched from SSNs would not threaten strategic stability as a "first launch" threat (since their yield would be too small to target ballistic missile silos) but would increase stability by providing an invulnerable reserve. Its mission would be to deter second, or follow-on, Soviet strikes should a nuclear exchange occur. Currie also noted that the debate on whether the cruise missile could successfully penetrate Soviet air defenses was largely irrelevant as those defenses would have been extensively damaged by earlier US strikes.

This indistinct mission for the SLCM proved politically useful within the Navy (even though some in Congress believed it was strategic nonsense). Conceptual flexibility offered naval innovators the means of overcoming significant obstacles in their quest for a long-range surface-to-surface missile. It also offered Defense Department officials the opportunity to urge the Air Force to work on the ALCM. And because it was ambiguous, the new SLCM mission did not raise undue suspicion in the carrier community. As long as a strategic cruise missile appeared to be the goal, the tactical antiship version could be treated as a fortuitous spin-off. So, although the Navy drafted a requirement for an antiship version of the cruise missile in November 1974, it purposely paced its progress behind the strategic version.⁴⁸

⁴⁶Betts, *op. cit.* in note 4, p. 89, as extracted from *Department of Defense Appropriations for 1975*, Hearings before the House Appropriations Committee, 93 Cong., 2 sess. (Washington, DC: Government Printing Office, 1974), pt. 4, p. 461. Also Currie interview, 21 September 1993.

⁴⁷*Ibid.*, as extracted from *Department of Defense Program of Research, Development, Test and Evaluation, FY 1976* (Defense Department, 1975).

⁴⁸Rear Admiral Walter Locke's testimony in *Fiscal Year 1975 Authorization Hearings*, pt. 7, pp. 3665-7.

This strategic rationale may have pacified Congress but not Zumwalt. As early as 1974, Navy studies had specified the SSN as the launch platform for the SLCM even though that mission would require diverting them from their primary role, antisubmarine warfare (ASW). Zumwalt wanted cruise missiles on surface platforms as antiship weapons. Before he left office as CNO in 1974, he designated all cruisers as platforms for the SLCM, particularly the newly proposed nuclear-powered strike cruiser. This particular proposal was not well received because some thought it would violate the requirement of minimizing the vulnerability of these platforms. Zumwalt received support from Clements who wouldn't approve another new shipbuilding program unless Tomahawk cruise missiles were included. As a result, Zumwalt got what he wanted from the beginning—a capable antiship missile for the surface navy.⁴⁹

Shortly after Admiral James Holloway became CNO, his Executive Panel, a group of businessmen and academics charged with advising him on the best directions to take the Navy, received a briefing from Locke on the SLCM.⁵⁰ One member of the Panel, Dr. Albert Wohlstetter, saw in the Tomahawk the weapon for which he had been looking. As one of the world's preeminent strategists, he had for years encouraged the Defense Department to develop a "zero CEP" weapon. He believed such a weapon could achieve nuclear effects using conventional warheads thus greatly enhancing strategic stability. Following Locke's briefing, Wohlstetter discussed his ideas with Locke (whom Wohlstetter recalls as not being excited about them). Locke, reports his recalcitrance was based on anticipated opposition within the Navy's hierarchy. Wohlstetter was disappointed and told the CNO that the Navy should pursue a conventional version of the Tomahawk.⁵¹

This was the first time development of a non-nuclear Tomahawk was raised. Holloway acted on Wohlstetter's recommendations and called a meeting with Long and Locke. Although Long told Locke that no action had been directed as a result of that meeting, Locke (who had already determined that he wanted increased accuracy in the Tomahawk) decided to press ahead with efforts to test Scene Matching Area Correlation (SMAC) guidance on

⁴⁹ ADM Zumwalt also saw the inclusion of SLCMs aboard surface ships as one final triumph over Rickover.

⁵⁰ The briefing was given on 7 October 1974.

⁵¹ Interview with Dr. Albert Wohlstetter, Los Angeles, CA, 18 September 1993.

SLCM.⁵² Locke asked his team to plan for a SMAC flight by the end of 1976. This was extremely ambitious considering that the first fully guided flight of any cruise missile with TERCOM was held in June 1976. Nevertheless, the first captive flight with SMAC was completed in November 1976. The first public mention of the conventional land-attack program was in an *Aviation Week & Space Technology* article in December of that same year.

Locke delayed further SMAC flight tests until after the next DSARC review since no one had asked for a conventional variant and a failure could prove damaging to the overall program. Because SMAC had serious limitations, the program was ended after a spectacular flight in 1978 and replaced by its derivative Digital Scene Matching Area Correlation (DSMAC). DSMAC test flights started in 1980. Pursuit of a conventional land-attack variant was a watershed for the Tomahawk. By placing a land-attack missile on a variety of surface combatants, the Navy's firepower was dramatically increased as was the Soviet's targeting problem. But the real doctrinal breakthrough was that surface combatants could now mount land-attack operations independently of the Carrier Battle Group in situations where only a limited air threat existed.

The Tomahawk Antiship Missile (TASM) was the only version that any subgroup within the Services even lukewarmly desired, but the Navy surface fleet had to proceed cautiously and indirectly to get it.⁵³ Furthermore, the Assistant Secretary of the Navy for Research and Development, Tyler Marcy, stressed before procurement hearings in early 1977 that the Navy's primary interest in the Tomahawk was the *conventionally-armed* antiship variant.

Following the IOC dates of SLCM, ALCM and GLCM (the ground-launched variant) into Service inventories, the missiles had still not gained full acceptance. Since they were unmanned systems there were valid political and Service concerns regarding their use (such as the fact that once launched they were not recallable). And as with any new system, their reliability in a hostile environment was unknown. Although considered, they were not used in operation Eldorado Canyon in the strikes against Libya in 1986. Hesitancy was

⁵²Locke reported that the challenge that unintentionally started him looking at SMAC was the remarks made by the chairman of the SLCM Steering Group that high precision guidance was years away, maybe ten years or more. He was determined to prove them wrong. [Locke interview, 28 August 1994]

⁵³Betts, *op. cit.* in note 4, p. 406.

based on several considerations. First, the Navy had just declared IOC of the TLAM-C (and doctrinal application was fragmentary). Some were also concerned that a failure at the tactical level would also make strategic use suspect, and that the potential existed for the technology involved to fall into the "enemy" camp were an unexploded cruise missile to land in Libya. Accounts also indicate that insufficient weapons were deployed to the Mediterranean at that time to produce the desired results. Therefore, the Gulf War marked the first time Tomahawks were fired in anger but they were only integrated into the attacks against Iraq after long deliberations at the Executive level.

Although cruise missiles were proposed for missions deemed too hazardous for manned aircraft during their development in the 1970s and 1980s, the political dimension of reducing the possibilities of Prisoners of War (POWs) was never mentioned in the books written on the subject up through 1982. POWs and their attendant political repercussions became issues after the disastrous air strike outside of Beirut, Lebanon, in 1983.

Presidents facing a crisis are now just as likely to ask "where are the Tomahawks" as they are "where are the carriers?" Conventional Tomahawks are now considered one of the weapons of choice to make political statements against rogue states. When the Soviet Union crumbled and the Russian submarine threat diminished, conventional Tomahawks assured that submarines and surface combatants still had a role and were capable of meeting the new security challenges. In fact this dispersed firepower was a primary reason the Naval Services were able to contemplate the new littoral warfare strategic vision detailed in . . . *From the Sea*.⁵⁴ The capabilities of conventional Tomahawk Land-Attack Missiles (TLAMs) also made the Navy determined not to bargain them away in arms reduction talks. Nevertheless, the fact that there are now compelling reasons to use cruise missiles in particularly hostile environments does not mean they are the best choice for all situations. Their relatively small "punch" and high unitary cost compared to a bomb limit their use when a greater level of effort is required.⁵⁵

Since the stress remained on nuclear cruise missiles, the conventional variant was slow to gain acceptance and didn't finally receive

⁵⁴ . . . *From the Sea: Preparing the Naval Service for the 21st Century* (Washington, DC: Department of the Navy, September 1992).

⁵⁵ Holsapple interview, 27 May 1993.

its due until the latter part of the Reagan Administration.⁵⁶ Even so, the TLAM-C actually moved ahead under Locke's leadership more quickly than critics had predicted.

Strategic Doctrine and the Tomahawk Mission. Changing strategic doctrine enhanced the development of cruise missiles. When James R. Schlesinger became Secretary of Defense in 1973, he was searching for a change to the doctrine of mutually assured destruction. His preference was for limited strategic options and the SLCM's capacity for "unambiguous, controlled single-weapon response" clearly filled a slot in what came to be known as the doctrine of flexible response.

Schlesinger's replacement in early 1976, Donald H. Rumsfeld, publicly was relatively noncommittal on cruise missiles. Privately, Rumsfeld pushed cruise missiles, especially the GLCM. As SALT II approached, cruise missiles became an increasing point of negotiation and Currie became noticeably more cautious in his support for them. In early 1976, the SLCM was quietly reclassified as a theater nuclear weapon system. The reclassification was so low key that the House Armed Services Committee was surprised to learn of it early the next year.⁵⁷ In part, this was due to political developments in Europe. Although the Tomahawk was not yet in production, its capability became important in response to Soviet nuclear capabilities threatening the Eurostrategic balance in the latter days of the Ford Administration and the beginning of the Carter Administration.

By April 1976, the Navy had decided that SLCM could be "invaluable in the projection of power ashore in tactical situations."⁵⁸ However, Henry Kissinger had agreed with the Soviets to ban Tomahawk from submarines and drastically limit them on ships. When President Ford consulted with the National Security Council on this matter, he was surprised at Admiral Holloway's vigorous opposition. The CNO was determined not to lose the Tomahawk. He

⁵⁶ *Ibid.*

⁵⁷ Betts, *op. cit.* in note 4, p. 90, as extracted from *Hearings on Military Posture and H.R. 5068 [H.R. 5970]: Department of Defense Authorization for Appropriations for Fiscal Year 1978*, Hearings before the House Armed Services Committee, 95 Cong., 1 sess. (Washington, DC: Government Printing Office, 1977), bk. 2, pt. 3, p. 1099.

⁵⁸ Huiskens, *op. cit.* in note 1, p. 45, from the *Fiscal Year 1977 Authorization for Military Procurement* hearings, p. 3333.

was supported during the next meeting by William Clements.⁵⁹ As noted above, the Navy clearly had developed uses for the Tomahawk apart from its potential as a strategic weapon. Even in the nuclear arena, its theater role was being stressed over the strategic. This was specifically explained in the 1977 hearings before a subcommittee of the House Appropriations Committee:

The primary need for the land-attack TOMAHAWK is in a theater role where its single warhead, high accuracy capability with resultant low collateral damage, penetrability and survivability make it ideal for use in limited nuclear attacks as a theater weapon. It represents one of the few new systems the U.S. could deploy if needed to maintain theater balance in the face of growing Soviet peripheral attack capabilities that include such systems as the Backfire bomber and the SS-20 mobile ground launched missile.⁶⁰

In his final report to Congress as DDR&E, Currie described the cruise missile as "perhaps the most significant weapon system development of the decade," and that although the tactical antiship version was initially a spin-off from the strategic program, it had now gained equal status.⁶¹ The strategic cruise missile primarily had been an OSD initiative (in response to strategic negotiations), rather than a Navy request. Within the Navy, the distinction between strategic and tactical (or theater) nuclear weapons was somewhat arbitrary.⁶² Admiral Locke presented the first explicit indication that the strategic SLCM had lost favor with the Navy. "The only purpose that we have for the submarine cruise missile is for theater war. That is a tactical mission. [The CNO directed study] provided the conclusion that the land-attack cruise missile was of use for the Navy in a theater role."⁶³

In January 1977, following the DSARC II meeting, Deputy Secretary Clements directed the full-scale development of GLCM starting in 1979.⁶⁴ Clements additionally created a Navy-Air Force Joint Cruise Missile Project Office (JCMPO) with the Navy as the lead service. Captain Locke was made the Program Manager (later called

⁵⁹ Locke interview, 28 August 1994.

⁶⁰ Betts, *op. cit.* in note 4, p. 91.

⁶¹ Huisken, *op. cit.* in note 1, p. 46.

⁶² Interview with Admiral Robert L. J. Long, USN, (Ret.), former DCNO, Submarine Warfare, Annapolis, MD, 16 July 1993.

⁶³ Huisken, *op. cit.* in note 1, p. 47. *Hearings on Military Posture and HR5068*, p. 1099.

⁶⁴ Locke interview, 28 August 1994.

Director). Furthermore, development was approved for all versions of the Tomahawk and for the extended-range ALCM-B. Even though the Tomahawk had yet to prove it had a mission, it now had full advocacy in OSD for final production.

Before completing the story (which is found in the section on the Joint Cruise Missile Project Office), a brief chronology of the complementary air- and ground-launched systems is required.

Air- and Ground-Launched Cruise Missiles

Navy reluctance to become involved with SLCM was minor compared to that of the Air Force, which had absolutely no desire to become involved with the air-launched cruise missile. They clearly viewed the ALCM as a threat to manned bombers and vehemently protested their forced involvement. Since becoming a separate Service, the Air Force has strongly identified itself with the manned strategic bombardment mission.⁶⁵ It is ironic, therefore, that ALCM developed from a decoy program that was initially intended to ensure the future viability of the bomber force. As the strategic importance of ALCM increased, its momentum carried the SLCM program along with it. In fact, for many not closely involved with the programs, the terms SLCM and ALCM were used synonymously. The differences were actually quite significant. Nevertheless, the programs remained intertwined until the ALCM was finally released from Joint Cruise Missile Program Office cognizance in mid-1980.

SCAD. Initially the Air Force desired a decoy for enhancing bomber penetration into Soviet airspace. As noted above, it was the initial work on a subsonic cruise armed decoy (SCAD) which provided the basis for ALCM. In 1968, the Air Force issued a "required operational capability" statement for an unarmed decoy to replace the Quail missile. As a pure decoy, the system was challenged from the start, most notably by Foster and later by Currie, who wanted armed missiles. The program which emerged was SCAD.⁶⁶ But in 1971, many, including some on the Hill, were considering the option of a standoff missile as an alternative to the penetrating strategic bomber.

⁶⁵ *Ibid.*, p. 362. Betts, *op. cit.* in note 4. While this is bureaucratically true, the earliest proponents of ALCM were, in fact, Air Force colonels. [Locke interview, 28 August 1994]

⁶⁶ *Ibid.*, p. 84.

The controversy lingered, became intimately entangled with the requirements for the B-1 bomber, and the SCAD was eventually cancelled by Currie in July 1973 for lack of support and potential.⁶⁷ It was at the specific urging of Secretary Clements that Congress, in late 1973, directed the Air Force to coordinate its cruise missile research programs left over from SCAD with those of the Navy and to submit the results of studies "that could provide such capabilities as a stand-off launch missile."⁶⁸ Debate began to focus on whether the ALCM should be viewed as an enhanced capability for the penetrating bomber, supplement it or replace it. The latter possibility naturally alarmed the Air Force.

The B-1 Versus the ALCM. The Air Force almost immediately began distancing itself from the ALCM. The Air Force Chief of Staff prioritized the ALCM behind both the B-1 and the new Air Force ICBM (MX).⁶⁹ In December 1974, the Air Force completed and submitted to Congress its "Joint Strategic Bomber Study" (JSBS) which countered recommendations being pushed in briefings by the Brookings Institution (which Brookings formally supported in a 1976 study). Both studies discussed the relative merits of modernizing the strategic bomber force. The Air Force emphasized the need for the B-1 whereas Brookings suggested that the costly and sophisticated B-1 was unnecessary.

Air Force opposition caused Currie to favor the SLCM over the ALCM and even to consider making the Tomahawk the standard. The House of Representatives entered the controversy in late 1975 by cancelling all money from the ALCM program while retaining funding for the SLCM. Funding was later restored but the Air Force only reluctantly pursued the ALCM in order to avoid getting "a torpedo rammed up its bomb bay."⁷⁰ It was a classic example of civilian leadership exploiting inter-Service rivalries to advance their agendas.

The crux of the JSBS/Brookings controversy was the relative virtues of the cruise missile. Would it be able to successfully penetrate Soviet airspace, would it be vulnerable to future Soviet air defenses,

⁶⁷ Currie interview, 21 September 1993.

⁶⁸ US Congress, *Fiscal Year 1974 Defense Authorization Conference Report*, House 93-588 (13 October 1973) and Senate 93-467 (16 October 1973), p. 36.

⁶⁹ Werrell, *op. cit.* in note 20, p. 156.

⁷⁰ *Ibid.*

or would the B-1 do a better job? Since both systems were still in the development stage, conclusions were mostly speculative. However, the relatively low cost of the cruise missile compared to the B-1 began to swing the arguments toward the ALCM. The Navy's long-range cruise missile program added another dimension to the Air Force's dilemma.

The Air Force tried to solve the challenge of the Navy's program by extending the range of the ALCM-A with an external fuel tank, but not to the point of threatening the rationale for the B-1. The Ford Administration had decided to build the B-1 but this decision was effectively deferred by Congress to permit the incoming Carter Administration to review the program.⁷¹ Both programs, but especially the B-1, had become partisan issues, with Carter promising to cancel B-1 production if elected.

Following a January 1977 DSARC meeting, Clements accelerated the ALCM's IOC target date from July 1981 to December 1980 because of its increasing strategic importance. He also selected the stretched version of the ALCM, the ALCM-B, as the airframe of choice. This was significant because the Air Force insisted the longer nineteen-and-a-half foot ALCM-B would not fit in the rotary launcher of the B-52 as it was prototyped. Months prior to this DSARC, Robert Parker, Deputy DDR&E, directed a measurement study for Clements, using Boeing models and figures. His conclusion was that the longer common air and sea Tomahawk *would* fit in the B-52 and, after staff verification, was prepared to present his findings to Clements.⁷² While Parker was sitting in Clements' office, Clements received a telephone call from Boeing (apparently instigated by OSD leaks to the Air Force staff) requesting that he not use the "WAGs" provided to Parker.⁷³ The Air Force was not interested in any version of the ALCM except the shorter ALCM-A which would fit in the rotary launcher and whose range was less of a threat to the B-1 program.⁷⁴ It was also their only hope to avoid putting Navy Tomahawks in B-52s. Many policymakers, including some Senators and Congressmen, saw this as a scheme to protect the penetrating bomber. The new Defense

⁷¹ Betts, *op. cit.* in note 4, p. 94.

⁷² Interview with Mr. Robert Parker, former Deputy and acting Director of Defense Research and Engineering, Irving, TX, 22 September 1993.

⁷³ "WAG" is an acronym for wild-ass guess.

⁷⁴ Parker interview, 22 September 1993.

Secretary, Harold Brown, initiated cost-effectiveness studies for alternative bomber forces which examined both vulnerabilities and carriage permutations. Conclusive answers demonstrating a superior arrangement, however, did not emerge. The B-1 remained a political hot potato for the Administration until President Carter announced the B-1's cancellation on 30 June 1977. He favored procurement of a large force of long-range ALCMs to be deployed on B-52Gs, which the Air force had hoped to retire.⁷⁵ Thus it was the Air Force's attempts to save the B-1 that ultimately contributed to its demise. Its worst fears came true—it lost the new penetrating bomber it wanted and got a cruise missile it didn't want.⁷⁶ Carter's decision nevertheless gave new impetus to the ALCM program.⁷⁷ As an Administration official later noted, "the existence of the B-1 made the cruise [missile] option feasible" since the B-1 could always be resurrected if the ALCM failed to meet its potential.⁷⁸

The Air Force continued to raise arguments to counter the assessments which led to the B-1's cancellation. However, tests conducted for the new DDR&E, Dr. William Perry, against simulated Soviet defenses, demonstrated that they would be "totally ineffective" against the ALCM.⁷⁹ As a result, Secretary Brown's first annual report to Congress in February 1978 reaffirmed the Administration's commitment to the ALCM stating that it "now has our highest national priority." The debate mentioned earlier about whether the SLCM was a tactical or strategic system thus became somewhat irrelevant. Air Force persistence paid off, however, and the Reagan Administration resumed B-1 production in the 1980s.

SLCM-ALCM Strategic Linkage. Although the internal Air Force struggle with the ALCM was peripheral to the development of the Tomahawk, the two programs were intimately related for strategic reasons. During the late 1970s, the United States sought a solution to the problem of bolstering NATO countries faced with the threat of increasing Soviet theater nuclear capabilities. A combination of

⁷⁵ Betts, *op. cit.* in note 4, p. 95.

⁷⁶ *Ibid.*, p. 370.

⁷⁷ Werrell, *op. cit.* in note 20, p. 177.

⁷⁸ Betts, *op. cit.* in note 4, p. 378.

⁷⁹ Huisken, *op. cit.* in note 1, p. 85, from *Aviation Week and Space Technology*, 20 November 1978, pp. 24-5.

air- and ground-launched cruise missiles was seen as the ideal counter to the challenge. Cruise missiles demonstrated US technological superiority and Secretary Brown believed they would help to "improve the world's perceptions of the potency of [US] forces."⁸⁰ Moreover, although it was admitted that the Soviet Union could eventually acquire the capability to defend against first-generation cruise missiles, such defenses would cost from \$30 to \$50 billion and take eight to ten years to deploy. In hindsight, these cost predictions for the Soviet Union proved exceptionally accurate.

SALT II Negotiations. As noted earlier, cruise missile development was also intricately linked to SALT I and II negotiations. As SALT II was finally drafted and signed in June 1979, many of the protocol provisions dealt with cruise missiles and strategic bombers. Since SLCM had been classified as a theater nuclear weapon, ALCM became one of the primary strategic negotiating issues. Within NATO, cruise missile technology allowed the US to regain some of the credibility it lost during SALT negotiations when the European perception was that its security had been negotiated away without being consulted.⁸¹ American allies' concern about the Soviet SS-20 led to the December 1979 decision to deploy Pershing IIs in West Germany and 116 flights of ground-launched cruise missiles in five other NATO countries. Political factors called for a visible and early deployment.⁸²

The Joint Cruise Missile Project Office

Air Force-Navy Confrontation. When the Navy was selected to lead the cruise missile project, it wanted the JCMPO to be part of the Naval Air Systems Command with the Air Force providing support and coordination for ALCM and GLCM. The Navy was viewed as the natural choice to lead the effort since it had made more progress in its development of the SLCM than the Air Force had with ALCM. The Air Force objected to this decision. The debate over who should be

⁸⁰ Betts, *op. cit.* in note 4, p. 96.

⁸¹ *Ibid.*, p. 400.

⁸² US strategists underplayed the capabilities of SLCM so that European allies could not reasonably use its existence as an alternative to basing GLCMs and Pershings on their soil. Thus, while the air- and ground-launched missile programs enjoyed solid political backing, the sea-launched Tomahawk was not supported. The Carter Administration did not want a nuclear-armed SLCM. [Locke interview, 28 August 1994]

the lead Service continued for several months. The issue went beyond the secretaries of the two Services to OSD. In a preliminary settlement, a 25 March 1977 memorandum was issued by Robert Parker, then the Acting DDR&E, directing that the JCMPO Director (Navy) and Deputy Director (Air Force) be responsible for the overall cruise missile systems development process. He further specified that the Air Force and the Navy were to transfer their program element funds for ALCM, GLCM and SLCM to the JCMPO. In January 1975, during an earlier attempt to increase commonality, the Air Force and Navy were also designated the lead Services for engine and guidance systems, respectively.⁸³

The leadership issue remained unsettled, however, and on 28 June 1977 Captain Locke sent a memorandum to NAVAIR stating that although the Charter for the JCMPO had been in the coordination cycle for several months, the Air Force still objected to the Navy being established as the Executive vice Lead Service. He also noted the Air Force was unhappy about being forced to collocate the GLCM project with the SLCM project in Washington, DC.⁸⁴ The problem was exacerbated two days later when B-1 production was cancelled by President Carter.

OSD Assumes Control. Finally on 30 September 1977, Dr. William Perry, the new Director of Defense Research and Engineering, issued a memorandum to the Secretaries of the Air Force and Navy stating that because the ALCM flyoff was elevated to a matter "of highest national priority," OSD would not allow the Air Force to continue to impede the creation of the JCMPO or its subsequent operation.⁸⁵ Perry directed that the present project management team be retained, that all Deputy Program Managers were to be collocated with the JCMPO, and that the JCMPO was a Chief of Naval Materiel Command-level designated project office. He once again directed the Air Force and Navy to allocate their entire cruise missile program funds directly to the JCMPO. In addition, Perry established an Executive

⁸³E. H. Conrow, et. al., *The Joint Cruise Missile Project, An Acquisition History—Appendixes* (Santa Monica, CA: Rand, 1982), pp. 3-4. Also Parker interview, 22 September 1993..

⁸⁴The Air Force cruise missile program was under the direction of the Aeronautical Systems Division (ASD) of the Air Force Systems Command (AFSC) and located at their program office at Wright Patterson Air Force Base, Ohio, where the majority of their personnel were located.

⁸⁵Conrow, *op. cit.* in note 83, p. 6.

Committee (EXCOM) to provide programmatic and fiscal direction with himself as chairman.⁸⁶ The original purpose of the EXCOM was to provide a forum for rapid review and discussion of problem areas and to build consensus concerning solutions. Dr. Perry, as the EXCOM chairman and now the Under Secretary of Defense for Research and Engineering (USDR&E; DDR&E's new title), acted as the senior authority whenever it became necessary to resolve disputes between the Services. It was probably the only way to force Service acceptance of a truly joint program in the 1970s.⁸⁷

Thus within a span of a few months, management of cruise missile development evolved from one of Pentagon hindrance to one where the Under Secretary of Defense fostered rapid problem resolution. This probably wouldn't have happened had not the ALCM emerged as a high national priority.⁸⁸ Throughout his tenure as USDR&E, Dr. Perry maintained oversight of ALCM, GLCM and SLCM projects. To further quiet inter-Service rivalry, the Program Manager position was designated a Flag rank assignment and the Deputy position (US Air Force) was a colonel. In March 1982, Captain Locke was promoted to Rear Admiral. Without Dr. Perry's direct intervention, expeditious and fiscally efficient development of the cruise missile would not have occurred.

Final Political Notes

Like any other organizational endeavor, military activity is fraught with political machinations. In this case, segments of the military Services did not want cruise missiles because they threatened their missions and doctrine, as well as competed for scarce funding. "The long-range air-launched cruise missile (ALCM) was rammed down the throat of the Air Force. The Army refused to accept development responsibility for the ground-launched cruise missile (GLCM). The Navy—specifically, the carrier Admirals—did not want the Tomahawk

⁸⁶Members of the EXCOM included DDR&E (chairman), the Assistant Secretary of the Navy (RE&S), the Assistant Secretary of the Air Force (RD&L), the Vice Chief of Naval Operations, the Air Force Vice Chief of Staff, the Assistant Secretary of Defense (PA&E), and the Assistant Secretary of Defense (Comptroller). After the first meeting, the Chief of Naval Operations, and the Commander Air Force Systems Command were added as permanent members. [Conrow, *op. cit.* in note 83, p. 14.]

⁸⁷Interview with Dr. William Perry, Secretary of Defense and former Director of Defense Research and Engineering, Newport, RI, 23 June 1993.

⁸⁸Conrow, *op. cit.* in note 83, p. 63.

Antiship Missile because it represented a clear and present danger to the mission of the carrier-based aircraft."⁸⁹ There was a "not invented here" mentality that was almost insurmountable among the Services.⁹⁰ Furthermore, the Air Force and Navy objected to a project manager who seemed to have been removed from their control. In order to streamline the cruise missile program, he was given direct communication links to the Under Secretary of Defense. This greatly facilitated program direction and allowed for rapid assimilation of technological breakthroughs.⁹¹ However, the JCMPO also aggravated and alienated the Services which had now effectively lost control of both their funds and their programs. The program director immediately became an outsider.⁹² The fact that the Navy and Air Force had completely different objectives also led to problems. "Anytime there's not a consensus, the budgeteers, or budget analysts, will bore right in until they get two sides," can demonstrate policy inconsistencies and then use them as justification to cut the budget.⁹³ Perry's Executive Committee was established to ensure inconsistencies did not develop but was not designed to be a rubber stamp group where Locke could go and receive approval by fiat. The EXCOM was a vehicle where concerned parties could come together and quickly get a decision on important issues.⁹⁴

Cruise missile development would not have proceeded as fast or gone as far had it not been for senior-level, civilian intervention bolstering the strong leadership provided by the Program Director.⁹⁵ Technological innovation abetted the development process, but by itself would not have created a self-sustaining momentum.

⁸⁹ Betts, *op. cit.* in note 4, p. 360.

⁹⁰ Clements interview, 16 June 1993. The Navy Secretariat's reasonable belief was that OSD was using the Navy to develop an Air Force missile. This contributed to its "not invented here" attitude. [Locke interview, 28 August 1994].

⁹¹ Wohlstetter interview, 18 September 1993.

⁹² Naval personnel, such as Vice Admiral Ken Carr, who held positions outside of the Navy's organization, were critical. Carr was Clements' Executive Assistant and helped maintain backdoor channels for Locke that were as important, if not more important, than formal chains of command. Interview with Vice Admiral Ken Carr, USN, (Ret.), former Executive Assistant for William Clements, Groton Long Point, CT, 24 August 1993.

⁹³ Interview with Mr. Al Best, SAIC, Alexandria, VA, 14 July 1993.

⁹⁴ Perry interview, 23 June 1993.

⁹⁵ Betts, *op. cit.* in note 4, p. 361.

"At every crucial stage in the development of each type of cruise missile, high level political intervention was necessary either to start it or to sustain it," particularly during the period from 1973 to 1977 when SALT II forced cruise missile advocates to bargain hard for systems which many in the military did not want.⁹⁶ As a result, by 1975 the Soviets began to take the American cruise missile seriously. As Governor Clements stated,

I don't think there's any question that our technology, in all its forms, [beat them]. I'm only counting this particular instance as one incident, but our technology in all of its elements beat them. There's no question in my mind that the Russians finally couldn't play in that ball game. They gave up. They didn't have the money, they didn't have the industrial base, they didn't have the staying power with all of these various components. They didn't have the staying power to keep up with us.⁹⁷

Service mavericks and zealots were required as well. Admiral Locke was certainly one and as director of the JCMPO he became a strong advocate who was able to professionally guide cruise missile development. He was replaced in August 1982 by Admiral Stephen Hostettler. The Navy insisted the change was necessary because of poor missile reliability and schedule delays.⁹⁸ Naval leadership also wanted "their own man" in charge of the process. Because Admiral Locke had effectively bypassed naval leadership to overcome numerous problems, he was considered an outsider. In fact, Locke had been appointed because he was a good program manager and somebody whom OSD could trust. His unique power base automatically placed him at odds with the Navy.⁹⁹ On several occasions, Clements intervened to save Locke's career because the Navy was trying to get rid of him. Locke was working on a program that wasn't in the Navy mainstream and they feared the emergence of another Rickover.¹⁰⁰ Nevertheless, without Admiral Locke's leadership, cruise missiles would not have been developed when they were.

⁹⁶ Werrell, *op. cit.* in note 20, p. 361.

⁹⁷ Clements interview, 16 June 1993.

⁹⁸ Werrell, *op. cit.* in note 20, p. 211.

⁹⁹ Currie interview, 21 September 1993.

¹⁰⁰ Parker interview, 22 September 1993.

Chapter 3

AEGIS—EVOLUTIONARY OR REVOLUTIONARY TECHNOLOGY?

Thomas C. Hone
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Introduction

On 1 May 1960, Air Force First Lieutenant Francis Gary Powers was shot down in his U-2 while conducting aerial reconnaissance over the Soviet Union. On 21 September 1964, the first flight of the XB-70, a hypersonic aircraft capable of speeds in excess of Mach 2.5, took place despite the fact that the program had been cancelled by Congress shortly after Powers was shot down—or almost three years earlier. Though the United States was not fully aware of it until the defection of Viktor Belenko in 1976, the Soviets were preparing to counter the XB-70 threat with the MIG-25 Foxbat. Consciously or unconsciously, the United States had once again employed a “Cost Incurring Strategy” which elicited a response from the Soviets and pushed their technological capabilities to their limit.¹ Moreover, US technology had been employed to produce an offensive capability which necessitated development of a Soviet defensive counter-capability, thus manipulating their technology base and forcing them to allocate scarce resources away from offensive weaponry. A case could be made that technological innovation of adversaries is interactive, and that innovation emanates from response to the postulated threat rather than through a conscious effort to push for radical technological breakthrough in most cases. Therefore *evolutionary technological innovation* appears to be the norm, and thus more acceptable within the military strategic culture than is

¹ See previous Chapter concerning how this strategy was deliberately followed in the case of the SLCM.

revolutionary technological innovation which relies more on unstructured and unforeseen events for its genesis.

Between the downing of the U-2 and the introduction of the Backfire bomber, the Soviets produced the TU-22 Blinder—an aircraft capable of Mach 1.5 at altitude—which entered service in 1963. That aircraft, though of limited utility, was capable of carrying the AS-4 Kitchen air-to-surface missile. By 1975, the extremely capable TU-22M Backfire bomber, which could carry the AS-4 as well as more capable AS-6 and AS-9 missiles, had entered service with Soviet Naval Aviation. Without belaboring how each of these events impacted the evolution of technology, a pattern of nearly simultaneous technological advancement between the two Superpowers emerged. Thus the impact of the rapidly evolving Soviet aviation threat to naval units was assessed during the 1960s and firmly established in the Center for Naval Analyses “Countering the Anti-Ship Missile” (or CAMS) Study.² Much of the analytical work had already been done as early as 1958³ by Richard Hunt of the Johns Hopkins Applied Physics Laboratory (APL) who used a series of carefully defined threat models to determine the possible future threat environment that would have to be countered by US naval forces.⁴ In this case, the United States found itself responding to offensive, although expected, innovation on the part of its major adversary that had profound implications for survivability of naval forces at sea.

Throughout this chapter, two dominant themes bear consideration. The first is the nature of *evolutionary technological innovation* as it applies to the Aegis system. The second is the conceptualization of Aegis by the Project Manager for that system, Rear Admiral Wayne Meyer, who saw it not merely as a required capability for countering the emerging trans- and hypersonic threats to the fleet—an evolutionary change in defensive capability necessitated by a corresponding

² Interview with Ms. Adelaide Madsen, formerly Special Assistant to the Project Manager of the Surface Missile System project; subsequently assigned to NAVSEA-06 in support of ASMS/AEGIS; and later assigned as Assistant to PMS-403 in the Advanced Surface Missile System office responsible for providing and analyzing intelligence and other information required for that project and for Aegis. (4 August 1993).

³ Thomas C. Hone “Coalition-Building and Program Innovation in the Navy: Strategies in the Middle Ranks.” Paper delivered at the 1986 Annual Meeting of the American Political Science Association, Washington D.C., 28-31 August 1986, while Professor Hone was on the Faculty of the Department of National Security Decision Making at the United States Naval War College, Newport, Rhode Island.

⁴ Madsen interview, 4 August 1993.

evolutionary capability enhancement in enemy offensive capacity—but as a Battle Group management and coordination system, which, by its very nature, was a revolutionary technological application with respect to warfare at sea.

The Politics Of Aegis Development⁵

Having established the threat-based context within which the Aegis development team was required to operate, let us now turn to the relevant political circumstances which helped or hindered their attempts to adapt technology to meet emerging threats.

In January 1983, the Navy commissioned *USS Ticonderoga* (CG-47), the first of a new and expensive generation of missile cruisers. The heart of *Ticonderoga* was its Aegis weapon system, consisting of a phased array radar (SPY-1), a tactical weapon system (to monitor the radar and direct the ship's antiaircraft missiles) and a battery of surface-to-air missiles. Aegis anti-air warfare (AAW) systems were designed to track, target and engage high numbers of incoming aircraft and cruise missiles. The purpose of the system was to protect Carrier Battle Groups from saturation missile attacks staged by Soviet aircraft and submarines. However, CG-47 carried more than just an AAW system. Linked to computers which monitored and directed AAW missiles were antisubmarine and surface target sensors and weapons, such as the LAMPS antisubmarine helicopter and the Harpoon cruise missile. With this variety of sensors, weapons and sophisticated tactical displays, CG-47 class ships formed the core of the Navy's Carrier Battle Group surface defense screen.

The essence of the system is its ability to screen and monitor, then track and attack, large numbers of radar contacts simultaneously. The Navy realized it would need such a system as early as 1958, when the Applied Physics Laboratory of Johns Hopkins University forecast the sort of weaponry that enemy naval forces could be expected to develop. The Navy's Bureau of Aeronautics, charged with aircraft and air-to-air missile development, had already begun work on an extended-range air defense system which employed missile-equipped fighters and airborne early warning surveillance planes, but they knew such an extended-range air defense system would have to be

⁵ Hone, *op. cit.* in note 3. This paper has been reproduced herein, with some editorial changes. Gratitude is extended to Dr. Hone for allowing us to use his insightful piece on the development of Aegis and to the American Political Science Association (who holds the copyright, used by permission).

backed up by missiles employed on carrier escorts. The Navy's Bureau of Ordnance had already developed several varieties of ship-launched air defense missiles, but no one had as yet created the kind of radar and missile system that could deal with the threats forecast by the Applied Physics Laboratory. Work on such a system began in the Bureau of Ordnance in 1959. Dubbed TYPHON (for the hundred-headed monster in Greek mythology), the new system was designed to track as many as 20 radar contacts simultaneously. But the new system's radars were heavy, bulky, unreliable and used enormous amounts of electrical power. As a result, the Secretary of Defense cancelled the project in 1963.

The Navy was already having trouble successfully operating its deployed anti-aircraft missile and radar systems, and in September 1962 the Chief of Naval Operations (CNO) declared a moratorium on further development in order to "establish an orderly Long Term Plan which takes into account the logistic, maintenance, and training problems of the Fleet as well as the technical opportunities presented by scientific progress."⁶ Priority was given to a program to make existing anti-aircraft missile systems meet their design goals in operations at sea.⁷ The Surface Missile Systems (SMS) Project in the recently created Bureau of Naval Weapons (following the merger of the bureaus of Aeronautics and Ordnance) was assigned this task. After TYPHON was cancelled, the CNO ordered SMS to create a new development office, later given the title Advanced Surface Missile System Project or ASMS. The task of ASMS was to find technological solutions to the problems which had made TYPHON so unwieldy and unreliable.

The basic engineering problem was to develop a radar which did not need a mechanically-aimed antenna. The standard tactic in 1963 was to assign one fire control radar antenna (or "illuminator") to each target, having already used a separate air search radar to identify contacts. The fire control radars were used to guide anti-aircraft

⁶ Norman Friedman, *U.S. Naval Weapons* (Annapolis: U.S. Naval Institute, 1983), p. 156.

⁷ At this time, the TARTAR D missile was the most advanced missile thought adaptable to naval requirements available. It was not a very capable system, however, even with whatever upgrading could be accomplished. It had very limited target handling capacity and though it was partially automated, it was still basically a manual system. Reaction times with TARTAR were extremely long. Even desired improved reaction times of around 45 seconds were unrealistic expectations. (Madsen interview, 4 August 1993).

missiles to targets within range. When numerous, high-speed *simultaneous* targets were approaching, mechanically-aimed radars were easily overwhelmed. The solution, then being developed, was an electronically-aimed, or "phased array," radar, which could move from one target to another almost instantaneously so as to properly distribute radar beams and defensive missiles among a host of targets. As the orders to ASMS from the CNO put it, the Navy needed "more flexible and standardized fire control systems for SAM ships" built around 3-dimensional radars and "multipurpose digital computers and digital data transmission."⁸ The mission of the ASMS office was to work with the Deputy Chief of Naval Operations for Surface Warfare to prepare general and specific "operational requirements" to guide civilian contractors in their efforts to design and build the new equipment.⁹

ASMS was responsible to several organizations in the late 1960s. There was a chain of command through the Surface Missile Systems Office to the Chief, Naval Ordnance Systems Command (the short-lived Bureau of Naval Weapons had been broken up to form the Naval Ordnance and Naval Air Systems Commands), and then to the Chief, Naval Material Command (NAVMAT). There was also a relationship to the Project's *sponsoring* office in the Office of the Chief of Naval Operations (OPNAV). The Chief of Naval Operations was responsible for training and preparing the Fleet for war. The Chief, NAVMAT, was the senior Navy procurement officer. His job was to coordinate the actions of the major Navy procurement bureaus. The CNO's chief influence within the Navy (then and today) was based on his office's responsibility to prepare the budget requests which, after review, the Secretary of Defense would submit to Congress. OPNAV was organized into many "sponsoring" offices, most attached administratively

⁸ Friedman, *op. cit.*, in note 6.

⁹ It should be noted that Aegis performance goals were expressed in terms of the basic operational performance that was required, like the number of targets that the system must be able to track, the range that the radar must achieve, the range at which interception must be able to take place, the Electronic Countermeasures (ECM) environments in which the system must be able to operate, the level of rain and chaff that it must be able to operate in, and the type of deceptive countermeasures in which it must be able to operate. Performance goals for previous systems were defined primarily on what was considered technically feasible rather than operational requirements established to counter expected threat parameters. In that respect, the Aegis program was fundamentally different than its predecessors because it was intended to develop a system that would meet future threats that had been carefully defined in intelligence estimates and thus the engineering challenges were amplified. (Insights provided by Ms. Adelaide Madsen, *op. cit.*, in note 2).

to procurement offices in the bureaus. The sponsor developed goals; the bureau offices supervised procurement. A bureau office (such as ASMS) needed the support of both its sponsor and its bureau chains of command to get budget requests approved. But "sponsors" were only that; they weren't part of the formal chain of command in which bureau offices were placed. Nevertheless, bureau office directors needed to maintain close and cordial ties to their sponsors in OPNAV. A poor working relationship could lead to a cut in funds.

Two changes in defense administration strongly affected ASMS in the late 1960s. The first was interest in the techniques used by the Navy's Special Projects Office (SPO) to push the Polaris ballistic missile submarine from concept to operational deployment. The success of SPO led the Navy to create a number of project offices, some within the procurement bureaus and others directly under administrative control of NAVMAT. The purpose was to focus money, talent and attention on a limited number of projects in order to speed innovation and improve administrative control. In 1966, SMS became just such a special project, PMS-403.¹⁰ In 1969, the Office of the Secretary of Defense made the second change: establishing the Defense Systems Acquisition Review Council (DSARC). DSARC was created to review major development and procurement efforts at three critical stages (project start, engineering development, and production) in their progression from exploratory development to full-scale production. The goal of this administrative innovation was to decentralize authority and responsibility for major acquisition programs to specially chosen project managers while keeping essential control over procurement in the hands of the Secretary of Defense. Both changes worked to the advantage of ASMS. The first gave the project more resources; the second gave the project the periodic opportunity to demonstrate its progress and thus ensure even more resources in the future.

By 1969, ASMS had chosen a prime contractor (RCA), and work that had begun on what the Navy christened the Aegis (for the shield of Zeus) system. In 1970, Navy Captain Wayne Meyer, former head of engineering at the Naval Ship Weapon Systems Engineering Station (Port Hueneme, California), was transferred to the Naval Ordnance Systems Command (NAVORD). Appointed manager of the Aegis

¹⁰ *Review of Navy R&D Management* (Contract No. N00014-74-C-0251, Booz Allen and Hamilton, Inc., 1 June 1976), Exhibits V-3, pp. 355-9.

project, he almost immediately faced problems from outside his office.

The Deputy Chief of Naval Material for Development recommended against further development of RCA's Aegis radar on the grounds that the cost would not be justified by the potential anti-air warfare benefits.¹¹ Chief, NAVMAT, did not agree, however, so his Deputy for Development appealed to the OPNAV staff. That there was a need for a new generation of AAW surface escort ships was generally agreed. What was not clear was whether RCA's solution to radar tracking and targeting problems was cost effective. The "show-down" in OPNAV set the Deputy Chief for Development (NAVMAT) and his ally, the CNO's Director of Research, Development, Testing, and Engineering, against the Navy's Director of Tactical Electromagnetic Programs, the Director of Navy Program Planning, and the Deputy Chief of Naval Operations (DCNO) for Surface Warfare, whose offices sponsored the Aegis project and the offices which would procure the Aegis ships. The DCNO for Surface Warfare argued that the Aegis project office had drastically reduced the phased array radar's weight, power requirements and cost, and that even greater reductions were likely in the near future as the radar system matured. The Director of Navy Program Planning defended the project office's management of Aegis development and stressed the need to move the new system into the fleet.

The CNO, ADM Elmo Zumwalt, Jr., was left with the decision. His dilemma was that technical specialists in the Aegis project office (supported by their NAVORD and NAVMAT chiefs) and their warfare sponsors in OPNAV (OP-03, the DCNO for Surface Warfare) believed that Aegis was too important to abandon whereas critics noted the cost of fielding Aegis was consuming much of the Navy's budget for engineering development. At the same time, ADM Zumwalt was committed to replacing the Navy's World War II surface escorts which were still in service. To make this escort replacement program affordable, ADM Zumwalt planned to ask Congress to fund a "high-low" mix of ships—low capability, less expensive escorts for convoy protection and high capability, higher speed escorts for work with carriers. The projected high cost of Aegis made ADM Zumwalt's

¹¹ This conflict, and others, are described in PMS-400 records. Dr. Hone was allowed to examine the relevant documents and cite unclassified materials. Thanks are due to then Lt. James Rubin, USN, for his help in digging through the records. A public account of much of the same story is "New Antimissile Ship Faces Further Storms as Cost, Doubts Grow," by John J. Fialka, *The Wall Street Journal*, 30 June 1983.

task of obtaining funds for large numbers of both "high" and "low" capability ships just that much more difficult. His first inclination, therefore, was to try to reduce the cost of Aegis. In December 1971, ADM Zumwalt asked the DCNO for Surface Warfare if the Aegis system could be scaled down and procured at a lower cost. The request was passed to CAPT Meyer, who noted that his office had already considered that option in September and rejected it.¹² The position of the Aegis project office was that the original system had to be developed. The Chief, NAVMAT, also believed a scaled-down Aegis was a waste of money.

At that stage ADM Zumwalt considered cancelling the whole project. He was angry because there was no AAW development plan to integrate the various ongoing AAW projects, and he correctly anticipated that Congress would resist funding sufficient numbers of an expensive, nuclear-powered Aegis ship. But cancelling Aegis would leave the Navy without any medium-range air defense and might threaten the future "high" capability surface escort program, which was then in the concept formulation and design stage.

Moreover, the Aegis project could not be faulted on grounds of inefficiency. At the CNO's direction, the Naval Audit Service had investigated the management of Aegis development. In its March 1972 report, the Audit Service commended the Project Office's management methodology. Eventually, powered flights of the Navy's own antiship missile (Harpoon) were conducted in July 1972, demonstrating the growing sophistication and potential of antiship cruise missiles. This threat could not be ignored and it pressured the CNO into making a decision in favor of Aegis, the only medium-range system which could knock cruise missiles down.

Thus in November 1972, the CNO finally approved a production schedule for the Aegis radar and control system, giving Meyer's office secure funding, *providing* the Navy and Congress could agree on a platform to carry the new system.¹³ Over the next four years,

¹²Early in the Aegis project various ways of doing a certain job or meeting a certain technical requirement were considered but it almost invariably took the same amount of money regardless of the technical approach taken or the way it was packaged. It was not possible to have an automated system with rapid reaction time, which was absolutely necessary; mid-course guidance; and requisite target-handling capacity without a complex system costing a lot of money. (Madsen interview, 4 August 1993).

¹³There appears to be a consensus among those interviewed for this study that lack of a decision on what type of ship should carry Aegis was the single most critical obstacle to the ultimate success of the project. (Madsen interview, 4 August 1993, and others).

however, debates over the proper ship platform for Aegis almost killed the system altogether. Aegis engineers faced a difficult problem: design a system which would fit a range of platforms (large or small, nuclear- or conventionally-powered, destroyers *and* cruisers), field test it with the Standard Missile (SM-2), and then have RCA produce it in time to match whatever platform the Navy and Congress finally agreed upon. The challenge for CAPT Meyer was that the platform issue was to a large degree out of his hands. The Navy had begun work on a new surface escort design in 1966. The approaching block obsolescence of the hundreds of destroyers built during World War II required large numbers of replacement ships; advances in threat technology and tactics required increasingly sophisticated (and hence more expensive) ships. The potential conflict between numbers and individual ship capability was laid out in the *Major Fleet Escort Study* of 1967, written in OPNAV's Division of Systems Analysis while (then) RADM Zumwalt was its director. As CNO, Zumwalt attempted to act on the conclusions of the study even though he well understood how hard it would be to persuade Congress to fund the construction of large numbers of expensive (and more capable) fleet escorts.¹⁴

Zumwalt also lacked complete control of shipbuilding. The real boss of ship construction in 1972 was ADM Isaac Kidd, the Chief of NAVMAT, and Kidd had immediate authority over the surface escort program. After a long exchange of memos in 1973, Zumwalt persuaded Kidd *not* to accelerate the design and production of the anticipated conventionally-powered missile-firing escort so that ship and Aegis development could progress together. Zumwalt hoped to mount Aegis on a conventionally-powered escort; nuclear surface ships were too costly to get in satisfactory numbers, and Zumwalt wanted to guarantee sufficient production to maintain Aegis development and manufacture. The first engineering development model of the Aegis radar had already been tested ashore, and Zumwalt wanted to pace Aegis development to match that of a conventionally-powered platform.

In 1972, CAPT Meyer was assigned to Chief of the Surface Missile Systems Office in NAVORD. He also retained his position as head of the Aegis Project and this expanded assignment signified the degree to which Aegis development dominated surface-based AAW systems.

¹⁴The problem of constructing affordable escorts is discussed in detail in Norman Friedman, *U.S. Destroyers* (Annapolis: U.S. Naval Institute, 1982).

In 1974, the Naval Ship Systems Command merged with NAVORD to become the Naval Sea Systems Command (NAVSEA). The Aegis Project Office became the Aegis Weapon System Office (PMS-403), and CAPT Meyer was promoted to Rear Admiral and made head of PMS-403 as well as Director of NAVSEA's Surface Combat Systems Division.

This organizational change was important to Meyer. For the first time, he had access to and control over ship design offices and direct, authorized contact with the sponsors in OPNAV. Before the reorganization, Meyer had headed a weapons system office. After 1974, he directed that office plus two others—one responsible for the design of a destroyer-size Aegis ship, the other for an Aegis cruiser. After the creation of NAVSEA, Meyer had three sponsoring offices instead of one, and the opportunities for him to act as an organizational entrepreneur increased.

Unfortunately, the struggle over the "proper" Aegis platform was just heating up about the same time the Aegis system itself was changing from just an AAW sensor/weapon system to one which could direct *all* AAW weapons and sensors for an entire Carrier Battle Group. This modification of Aegis system goals was made, not to build a PMS-403 empire, but because it became technically feasible. The Navy had originally developed digital communication links for carriers and their escorts in order to allow one ship to coordinate and control the massed AAW firepower of a whole group believing that capability eventually would be developed. RADM Meyer believed that Aegis computers and software could revolutionize the conduct of Carrier Battle Group defensive operations. He saw the Aegis ship as mainly a command center, and only secondarily as an AAW escort.¹⁵ Through 1974, he made his point to his superiors in NAVSEA and NAVMAT and to a variety of offices in OPNAV. By December 1974, Meyer had persuaded the Chief of NAVMAT to consider a redefinition of the Aegis combat system, and it seemed that the Aegis program had entered a new (but logical) stage of development.

PMS-403 ran into two problems however. The first was a debate between the Navy and OSD about the proper design of the Aegis platform. The new CNO, ADM James Holloway, favored a

¹⁵ Correspondence with Mr. A. W. Doherty, former staff assistant to RADM W.E. Meyer. This point was also highlighted by VADM James H. Doyle in an interview conducted on 11 October 1993.

nuclear-powered ship. OSD was opposed to the nuclear-powered alternative on the grounds of cost and numbers: too few ships at too high (\$600 million, projected) a cost. OSD also criticized the nuclear-powered escorts (*California*-class) then being completed as "loaded from stem to stern with technically achievable, but not very practical, systems and subsystems."¹⁶ As Vice Admiral E.T. Reich, then working in the Office of the Deputy Secretary of Defense, noted in February 1975, "the Navy had done an inadequate job of specifying overall ship system integration design—systems engineering and total ship design integration have been seriously lacking in post-World War II surface ship acquisitions."¹⁷ This concern was shared by Meyer, and he argued that the rational solution was to give the combat systems office (PMS-403) authority over the design of the ship—control, not merely the right to negotiate or coordinate.

Meyer's proposed solution was novel but it was not unreasonable. Unfortunately, Congress intervened and the issue over the proper Aegis platform rapidly became politically controversial, placing several key decisions beyond Meyer's effective influence. The conference committee report on the FY 1975 Defense Authorization Bill stated that future authorizations for Aegis would be withheld unless the Aegis AAW system was tested successfully under operational conditions and then maintained at sea by "shipboard personnel only." The report also demanded that the Navy and OSD agree on the design of the Aegis platform and that the Navy produce a "cohesive integration plan specifying the interface of Aegis with the platform(s) and other weapon and command/control systems."¹⁸ In July 1974, Congress approved Section 804 of Title VIII of Public Law 93-365 ("The Nuclear Powered Navy"), which stated:

All requests for authorization or appropriations from Congress for major combatant vessels for the strike forces of the United States Navy shall be for construction of nuclear powered . . . vessels . . . unless and until the President has fully advised the Congress that construction of nuclear powered vessels . . . is not in the national interest. Such report . . . shall include for consideration by Congress an alternate program of nuclear powered ships with appropriate design, cost, and schedule information.¹⁹

¹⁶ Memo from Leonard Sullivan, Jr. (Assistant Secretary of Defense, Program Analysis and Evaluation) to the Secretary of Defense, 4 February 1975, in PMS-400 files.

¹⁷ *Ibid.*, Reich's words were quoted by Sullivan.

¹⁸ *Congressional Record-House*, 24 July 1974, p. 24942.

¹⁹ *Ibid.*, p. 24936.

Important elements in Congress wanted the Aegis ship to be nuclear; so did the CNO and VADM H.G. Rickover, director of the Navy's nuclear propulsion program. OSD was opposed. The deadlock threatened to kill Aegis altogether.

To satisfy Congressional demands that Aegis be tested and maintained at sea, RADM Meyer had the land-based prototype systems (radars and computers) moved from the RCA plant in New Jersey to the test ship *USS Norton Sound*. In just over three months in the summer of 1974, *Norton Sound* was converted into an AAW ship complete with radars and missiles. By December, *Norton Sound's* AAW tracking and fire control capability had been proven superior to that of any other Navy AAW ship, and actual test firings against a variety of targets in January 1975 were a success.²⁰ The results were impressive enough to convince the Secretary of the Navy to release money that had been withheld pending the outcome of the sea trials. Even so, Meyer could not resolve the dispute between the Navy and OSD about the Aegis ship design. He favored a mix of both nuclear- and conventionally-powered ships, but the procurement costs associated with nuclear propulsion (estimated at 4 to 1 over a conventionally-powered ship) were more than OSD could accept. In January 1975, OSD decided not to ask Congress for any FY 76 funds for Aegis ship construction or conversion. RADM Meyer termed the decision "unacceptable for a stable program in Congress."²¹

But the Admiral was not the only one upset. When the Ford Administration deleted a request for money for the lead nuclear-powered Aegis cruiser from its FY 76 budget, the Research and Development Subcommittee of the Senate Armed Forces Committee dropped money for all Aegis ship development from its FY 76 authorization. That posed a major problem for RADM Meyer. Three project offices were responsible for producing Aegis ships: PMS-403, the AAW system and missile office; PMS-389, which was supposed to oversee procurement of a conventionally-powered Aegis destroyer; and PMS-378, the nuclear-powered cruiser office. Aegis-related offices had grown in size, anticipating increased work on the ships; the Congressional response to OSD's opposition to the nuclear cruiser promised to leave all three project offices without money. As RADM Meyer informed his superior at NAVSEA, "We are simply

20 J. Philip Geddes, "Aegis Protects the Fleet," *International Defense Review*, No. 2, 1983, pp. 147-54.

21 Undated memo, PMS-400 files.

unable to accomplish sensible program planning, or useful contractual work."²²

In May 1975, the Chairman of the House Armed Services Committee fired another salvo against OSD: "the committee tied the use of RDT&E funds for Aegis to your provision of a plan for a nuclear platform for Aegis. . . . As a start we expect to have Aegis installed promptly on the *USS Long Beach*"²³ (the first nuclear-powered cruiser, launched in 1961). That same month, the CNO told the Secretary of Defense that Congress would eliminate *all* Aegis funding if OSD did not stand firmly behind some Aegis platform. The Chairman of the House Armed Services Committee also wrote to President Gerald Ford arguing that major surface combatants should be nuclear-powered and denouncing the influence of "systems analysts" in OSD.²⁴ Also in May, VADM Rickover, *de facto* director of the Navy's nuclear ship programs, went so far as to advocate to the CNO that the Navy propose to Congress construction of a nuclear-powered destroyer *without* Aegis. In June, Senator Strom Thurmond, of the Senate Armed Services Committee, asked VADM Rickover to make his views public; Rickover responded by endorsing the House Armed Services Committee demand that *Long Beach* be converted and that future Aegis ships be nuclear-powered.²⁵ Behind the scenes, however, the Navy and OSD had been considering an Aegis destroyer powered by gas turbines as a companion to the nuclear-powered Aegis cruiser. Rickover's concern was that the Congressional Appropriations Committees would compare the costs of the two ships and opt only for the conventionally-powered destroyer. Meyer's concern was that his project would not receive any funding for the next fiscal year and simply collapse.²⁶ OSD

²² Memo, from RADM W.E. Meyer to VADM R.C. Gooding, 28 April 1975, para. 5, PMS-400 files.

²³ Letter, 6 May 1975, Congressman Melvin Price to James Schlesinger, Secretary of Defense, in PMS-400 files. *Long Beach* appeared to be a prime candidate for Aegis because she already carried phased array radars. But her radar was primitive compared to the Aegis SPY-1, and "conversion" would have been, in fact, reconstruction.

²⁴ Letter, 13 May 1975, from Congressman Melvin Price to President Gerald R. Ford, in PMS-400 files.

²⁵ Senator Thurmond wrote to Rickover on 11 June. Rickover responded three days later. Notes on their exchange are in the PMS-400 files.

²⁶ He said as much in a memo to the Chief, NAVSEA, on 3 June 1975. If the emergency money had not been allocated to NAVSEA, Aegis offices would have closed down 1 August 1975.

proposed to senior members of the House and Senate Armed Services Committees that they authorize production of gas turbine and nuclear-powered Aegis ships separately. While they considered that proposal in July, the Chief of NAVSEA requested (and eventually received) emergency funds from the CNO's office in a desperate effort to keep the Aegis offices (PMS-403, PMS-389 and PMS-378) fully staffed.

Aegis was finally saved in a House-Senate Conference Committee meeting in September 1975. President Ford greatly influenced this decision by promising to justify in writing the need for a gas turbine Aegis ship. OPNAV also strongly supported Aegis. VADM James Doyle, the Deputy CNO for Surface Warfare (OP-03), was a strong Aegis supporter and he persuaded ADM Holloway to support the proposal to place Aegis in an existing gas turbine-powered destroyer design (Spruance). Meyer was another reason Aegis survived. Trained as an engineer (at University of Kansas, MIT, and at the Naval Postgraduate School), Meyer gradually and deliberately gained the respect of Congressional staff aides and members of Congress. According to one of his civilian assistants, Meyer established his legitimacy as a systems engineer both in the Navy and in Congress in 1975. His argument that Aegis should not fall victim to a dispute over its platform apparently had some effect. FY 76 funding for conventionally-powered and nuclear Aegis ships was \$45 million (up from \$16 million in FY 75); the radar/control system/missile office (PMS-403) was funded at \$66 million.

Development began in earnest in 1976 for the three Aegis offices in NAVSEA. With money appropriated in 1975, PMS-403 began construction of an Aegis Combat System Engineering Development Site (CSEDS) at the RCA plant in Moorestown, New Jersey. CSEDS was designed as a software testing and development site, a training center, and as the testbed for the whole Aegis combat system. RADM Meyer had been criticized by OSD in 1975 for wanting to put it on RCA property, but he made the case that there were no other logical sites. In 1976, work also proceeded on designs for the nuclear- and conventionally-powered Aegis ships. The most important event in 1976, however, was the establishment of the Aegis Shipbuilding Project (PMS-400) that October, with Meyer as Project Manager. PMS-400 was created by combining PMS-403, PMS-389 and PMS-378 into one NAVSEA office. OPNAV sponsors were also combined into one unit, OP-355. PMS-400 was given responsibility for developing and producing the Aegis combat system. It was the first "hardware" organization given authority over shipbuilding, but that was just what RADM Meyer wanted. He had criticized recent nuclear cruisers on the grounds that their

sensor and weapons systems were poorly integrated, and that they lacked the capability to manage Battle Group anti-air and antisubmarine information and weapons in major engagements. His criticisms were supported by officials in OSD and accepted by Congress. The order creating PMS-400 was the Navy's solution to the systems integration obstacle.

Rear Admiral Wayne Meyer: Manager And Entrepreneur

According to one of RADM Meyer's former deputies, "Without Rickover, the Navy would have gotten nuclear power in submarines. There would have been no Aegis ship in the Fleet, however, without Meyer."²⁷ A former PMS-400 analyst, with over two decades experience in AAW development, noted that Meyer brought to the Navy its best example of integrated systems project management. But it wasn't easy for the Admiral. When he was appointed Manager of the Aegis Shipbuilding Project, he had to (1) organize his staff, (2) prepare designs for contractors, (3) develop a working relationship with his sponsor in OPNAV, (4) make sure Aegis ships met Fleet needs, and (5) keep Aegis afloat in Congress. The last task was threatened by the growing cost of ships and the Navy's demand for large numbers of them. Converting *Long Beach*, for example, was estimated to cost nearly \$800 million, more than the estimated price of a new conventionally-powered Aegis ship. But the Authorization Committees were dominated by advocates of nuclear power, so the pressure to convert *Long Beach* was strong. Congressional Appropriation Committees, on the other hand, were searching for places to cut costs. Aegis was pressured from two directions at once—by the debate over the value of nuclear propulsion (endurance vs. numbers), and by the push for economy (which threatened both nuclear and conventional Aegis platforms).²⁸

²⁷ The following present or past Aegis staff were interviewed: CAPT L.H. Sebring, USN (Ret.), former Deputy Project Manager in PMS-400; Mr. Robert E. Gray, Plans and Programs Head, PMS-400; Mr. Donald May, the Applied Physics Laboratory; and CAPT D.H. Barnhart, USN, former Operations Division Director in PMS-400. VADM Thomas Weschler, USN (Ret.), who directed the missile-armed surface escort development program in the Naval Ship Systems Command in the late 1960's, was also interviewed. Their comments have been incorporated but, in order to save space, specific interviews have not been cited.

²⁸ The fuss over nuclear power, aircraft carriers, and the Navy's role in national defense is discussed in several articles in *Armed Forces Journal International*, "Navy's Biggest Threat May Be Too Many Friends," (June 1977); "Sec Nav Blasts OSD Budget Guidance; New Draft Is On President Carter's Desk," by B.G. Schemmer (April 1978); "Senior

In 1977, for example, the Congressional debate over whether to fund *Long Beach's* conversion was strongly influenced by a dispute over whether to authorize a new nuclear-powered aircraft carrier. The Carter Administration had first proposed constructing a large conventionally-powered carrier, but Congressional critics, such as Senator Robert Taft of Ohio, favored construction of several smaller and cheaper "sea control ships" in its place. The authorization committees promoted a nuclear-powered version. Regardless, PMS-400 received almost \$940 million for the construction of the first Aegis gas turbine ship in FY 78, and some money was even appropriated for further study of the nuclear-powered Aegis "strike cruiser."

RADM Meyer was also able to get the Chief, NAVSEA, to support a charter for PMS-400—a charter which Meyer himself wrote. The charter (1) made Meyer responsible directly to the Chief, NAVSEA, (2) authorized Meyer "to act on his own initiative in [any] matter affecting the project," (3) named Meyer the delegated authority of the Chief of Naval Material, (4) centralized control over Aegis ship procurement and Aegis system development in PMS-400, (5) made Meyer fully accountable for Aegis ship acquisition, (6) gave Meyer responsibility for preparing and signing the fitness reports and performance ratings of all military and civilian personnel assigned to PMS-400, (7) made Meyer responsible for "total ship system engineering integration," and (8) gave PMS-400 the duty of integrating all the logistics requirements for Aegis ships.²⁹ It was a major grant of authority. Developing force-level requirements, operational concepts, ship characteristics and doctrines was the duty of OP-03 (DCNO for Surface Warfare). There, Meyer had the support of VADM Doyle and his deputy, RADM Rowden (OP-35).³⁰

After 1977, the Navy had problems with OSD and President Carter. In May 1977, for example, the President announced that his Administration would request Congress to authorize 160 new ships for the Navy over the next five years; one year later, Carter reduced that figure by half. Carter changed his mind about the Navy's shipbuilding

(con't) Pentagon Officials Miffed at Navy Public Relations Campaign for More Money," by B.F. Schemmer (May 1978); and Debating the Real Issues About the Future of the U.S. Navy," (May 1978).

²⁹ NAVSEA Instruction 5400.48, 6 June 1977, in PMS-400 files.

³⁰ Memo, VADM J.H. Doyle, Jr., DCNO (Surface Warfare), to RADM Meyer, 25 May 1977, in PMS-400 files.

program because of studies in OSD which suggested (1) that a major shipbuilding program would draw funds from the Army and Air Force and (2) that aircraft carrier survivability was much reduced in areas like the Mediterranean and Norwegian Seas. Defense Secretary Harold Brown was not convinced that the Navy needed 15 or even 12 Carrier Battle Groups, and his position carried the President. The Navy, however, strongly disagreed. In 1977, the CNO authorized the Naval War College to begin a study of future force needs; parts of the study (*Sea Plan 2000*) made public in March 1978 directly contradicted the views of Defense Secretary Brown. The Associate Director of the Office of Management and Budget accused the Navy of releasing parts of *Sea Plan 2000* just to get Congressional attention and support. The Vice Chief of Naval Operations responded that, "We must avoid paralysis by analysis—a situation in which we talk about our Navy while our potential enemy is building his."³¹

There was, in fact, a deep rift between Defense Secretary Brown and Navy Secretary Graham Claytor. In February 1978, Claytor wrote an angry memo (later made public) to Brown attacking OSD's FY 80 Consolidated Guidance to the military Services. In it, Claytor argued that the Carter Administration's effort to reduce spending was having a negative effect on national strategy. As the Navy Secretary put it:

There is, I suppose, an inevitable bureaucratic tendency to rationalize that our strategy need not be cut back to fit budget cutbacks. I firmly feel, however, that where we will have to refine our national strategy now or in the future, to match force programming reduction, we should explicitly say so.

Congressional opponents of the President, including such prominent Democrats as Senator John Stennis, Chairman of the Senate Armed Services Committee, and Representative Charles Bennett, head of the House Armed Services Committee's Subcommittee on Seapower, exploited the Navy's complaints to attack the Administration's defense and foreign policies.

According to a PMS-400 internal memo, there were three navies under scrutiny by Congress in 1977: the Administration's, one favored by Bennett (which was built around nuclear-powered carriers), and one based on proposals put forward by Senators such as Robert Taft. By 1978, the three had become essentially two: the President's and the Congressional Defense Authorization

³¹ Quoted in "Sea Plan 2000 Naval Force Planning Study," *Armed Forces Journal International* (May 1978).

Committees'. The stand-off both hurt and helped PMS-400. On the debit side, PMS-400 lost its proposed nuclear-powered Aegis platform; on the plus side, the debate over the cost of building up the Navy actually made the conventionally-powered Aegis ship (built on a modified *Spruance*- class destroyer hull) look better and better. ADM Thomas Hayward, the new CNO, testified to Congress that, without Aegis, existing Carrier Battle Groups would be at great risk in the 1980s. ADM Hayward felt that the Carter Administration did not comprehend the strategic value of the Navy's carrier forces and he initiated a series of studies to analyze the Navy's contribution to a European war. He also supported Aegis. As a result of Hayward's support, Congressional opposition to President Carter's reductions in defense spending, and RADM Meyer's ability to convince members of the House and Senate Defense Authorization Subcommittees that Aegis would work, FY 78 money was authorized for the lead Aegis destroyer (later to be classified as a cruiser).

Meyer's Congressional Strategy

Meyer was no novice when it came to dealing with Congress. An operations research specialist then on the staff of PMS-400 recounted this story from 1978:

Admiral Meyer was being grilled by a hostile Senator in an Armed Services Committee hearing on a particularly stormy afternoon. The Admiral was defending the Aegis phased array radar, and he hit the table in front of him at the climax of his statement. At that instant, there was a loud thunderclap and the windows rattled. The Senator said, "Okay, Admiral, I believe you. You don't have to do it again." We all got a good laugh out of that one.

Meyer was more serious about his strategy:

In those days, there was a protocol, there was discipline . . . there were some damn hard people on Congressional staffs, but they were straightforward people. I can't recall cases of staff people whose word didn't mean anything. That's very important—that your word mean something. . . . You can't do business with people if their word doesn't mean a goddamn thing. Well, try as they might, they could never accumulate as much knowledge as we had on the subject, so they had to make a decision and it was, "Who are we going to trust?" . . . My experience with them was to be as straightforward as I knew how and put it in comprehensive terms. Those people over there, in that era, could understand BS fairly fast, but they grasped honesty pretty quickly, too. When you're in trouble, they need to know you're in trouble. . . . You've got

to develop a relationship, and it takes quite a while to work that relationship out.³²

Former members of PMS-400 testify to RADM Meyer's understanding of Congress in the late 1970s. One referred to Meyer as a "master communicator," almost always ready with the right turn of phrase.

Meyer targeted his key audiences and dealt with each accordingly. Meyer knew he had to establish his legitimacy with each—with the authorization committees of Congress, with OPNAV, with OSD, and with his prime contractors. To deal effectively with Congress, Meyer studied the views and needs of key members and mastered the timing of the budget process. He also sometimes bypassed the Navy's own Legislative Affairs Office, a tactic which was to cost him dearly later, but one which he used successfully when there was much acrimony between the White House and the Navy Department. To Congress, Meyer presented himself as a teacher, an engineer and a competent manager. PMS-400, like the Polaris Missile Systems Project Office after which it was modeled, developed its own special management methodology, called F2D2, for "Functional Flow Diagrams and Description." F2D2 was a systems engineering technique which broke down the actions of Aegis into functional components. Meyer argued that systematic analysis of Aegis systems' functions with F2D2 saved time and money and improved Aegis' ability to counter air-borne threats. In the hands of the Admiral, it was an impressive argument.

Meyer's Approach To The Navy And OSD

Meyer's techniques were dramatic, decisive and reflected his upbringing. Raised in rural Missouri, he joined the Navy as an enlisted man at age 17 in 1943. After the war, he earned a BS in electrical engineering at the University of Kansas and then, years later, an MS in aeronautical engineering from MIT. At an early age, he was inspired by dedicated if stern parochial school teachers and he never lost the ideals of hard work and self-reliance which they gave him. As an executive, he was demanding, "often indecisive," and just as often "cantankerous." But his flair for the dramatic could be useful. For example, he had his aides persuade the wife of the President to

³²Interview, 1 August 1985. All of RADM Meyer's comments in this section are drawn from this interview.

promise to christen the first Aegis ship on Armed Forces Day in 1981, and PMS-400 had the ship (CG-47) ready and on budget by that date.

To win support within the Navy, Meyer brought representatives from many Navy shore activities into PMS-400 by "double-hatting" them (that is, by giving them positions of responsibility within PMS-400 in addition to their regular jobs). The stratagem not only created teams of Aegis advocates in the Navy's shore-based support organizations and within OPNAV, it also fed valuable experience into the Aegis technical group. A former deputy to Meyer, for example, credits this policy with alerting PMS-400 to the problems electromagnetic pulse might cause the Aegis phased array SPY-1 radar. Meyer also took a very positive, aggressive approach to his relations with OSD, and it paid off. He viewed the DSARC process as an opportunity, not a burden. One former aide said Meyer often used DSARC reviews to discipline his major contractors, RCA and Litton Industries (owner of Ingalls Shipbuilding). Another said Meyer felt that the DSARC process forced PMS-400 to be constantly alert, constantly tracking the progress of the Aegis system and its destroyer platform to head off any major delays or cost overruns. By meeting DSARC deadlines, PMS-400 could—and did—satisfy two important audiences: OSD and Congress.

Ingalls Shipbuilding won the competition to construct the Aegis ship in September 1978, and DDG (later CG) 47 was laid down in January 1980. PMS-400 had money for the first two ships and for development of what Meyer termed Battle Group Anti-Air Warfare Coordination (BGAAWC, pronounced like "squawk") system. With money and Congressional support in hand, Meyer focused on satisfying OSD imposed deadlines and on supervising contracts. As the Admiral noted:

At its peak, that project (PMS-400) never exceeded 120 people; most years, the project had only 70 people in it. I kept harping and harping on them about amplification. You can't ever forget that you're only one man-year, so if you're going to get anything done, you have to find a way to amplify, and the only way you can amplify is through people. The Aegis effort in the end was an amplification into thousands of man-years.

"Amplification" meant the following:

1. Making PMS-400 field representatives *de facto* Deputy Program Managers, so that contractors dealt regularly with an office possessing real authority.
2. Travel, with frequent on-site inspections and reviews. According to one witness, Meyer could be "ferocious" in these reviews, particularly at RCA and Ingalls. But his goal was to make adhering to production schedules a matter of

pride. As one former staffer in PMS-400 said, "Meyer loved to kick the tires." That meant lots of visits, even to subcontractors. RCA, for example, used PMS-400 to discipline Raytheon, one of its major subcontractors. And Meyer traveled regularly to smaller subcontractors, handing out efficiency awards and exhorting quality work.

3. Testing in parallel with production. PMS-400 "tested the hell out of the system," according to a former Operations Division Director, because Meyer didn't want any surprises. His goal, after all, was to produce a revolution in naval weaponry, and he was determined to turn his vision of warfare into a working reality.

4. Not allowing PMS-400 to become captive to routine. *All* the former staffers of PMS-400 interviewed for this study said RADM Meyer was a very demanding manager. Yet all respected him. They admired his fierce concern for excellence. As he himself admitted, "I harped on that and harped on that from day one." They also admired his willingness to listen. One noted that Meyer was often not sure how to translate his "visions" into reality, so that senior contractor personnel wasted lots of time on ideas which didn't pan out. But work was never dull. Meyer tapped key PMS-400 junior staff to answer Congressional questions and write speeches, and senior staff to hand out "Aegis Excellence Awards." About every six weeks, the Admiral called a halt to travel, stuffed all of PMS-400 into a conference room, and reviewed the project's status. He also gave out awards and "fired up the crowd." Then it was back to travel and meetings.

5. Getting practical control of much of his contractors' organizations. Meyer reached around RCA and Litton management to communicate with the people doing the work. Meyer also used the Applied Physics Laboratory and a number of independent consultants to review both technical and managerial practices employed by his major contractors. His goal was to create a community of Aegis supporters and experts. As one of Meyer's former Deputies put it, "Meyer built a national organization through his prime contractors."

6. Keeping fleet organizations informed with briefings, newsletters, films and demonstrations. The Combat Systems Engineering Development Site (CSEDS) was used to show high ranking Navy officers and influential members of Congress what Aegis could do, but it was also turned into a training station for AAW software development. To Meyer, Aegis was not a static system, and the heart of its "evolution" was its software. CSEDS both modified the software and showed it off. PMS-400 also planned programs to maintain and modernize Aegis ships.

7. Justifying Aegis to keep potential opponents quiet. Again, all responsible personnel in PMS-400 were tasked to defend Aegis against criticism. In the process, they often anticipated real problems and potential criticisms; the justification process was itself a planning tool.

Entrepreneur's Whiplash

Meyer's sense of drama flowed logically from his perception of his role as Project Manager. As he pointed out:

One of the things you learn about program management is that it's not unlike being a politician. You have to get the little people with you . . . if you don't believe this is a democracy, you ought to be a Project Manager for a while . . . everybody votes on your performance every day. Success is dependent on getting the people behind you. . . .

But there were people in the Navy critical of Meyer's fierce dedication. Their concern was that Meyer, like Rickover, would become so closely identified with his program that critics of the Admiral would target the program to get back at him. Meyer's critics within the Navy feared he was growing overconfident, even arrogant, despite signals from Congress that the bill for the Aegis program was just too large. Between 1973 and 1980, for example, public opinion completely turned around (from negative to positive) on the issue of defense spending. This change was noted in Congress. In September 1979, Democratic Senator Ernest Hollings of South Carolina proposed that Congress increase spending on defense in real terms by three percent in 1980 and by five percent in fiscal years 1981 and 1982. His position was directly opposed to that of President Carter, and it was a sign of just how deep the division was between the President and Congress. Later that year, Soviet forces invaded Afghanistan, and Carter requested a rise in defense spending in what turned out to be his last budget. PMS-400 looked safe—first as a ward of Congress and then as part of a renewed defense spending program begun under Carter and extended by the Reagan Administration.

But public opinion shifted again. In April 1981, an ABC/*Washington Post* national opinion poll revealed that only 15 percent of the public thought that Reagan Administration defense spending was too high. The corresponding figure in a March 1982 poll was 40 percent. Again, the political potential of such a shift was not lost on members of Congress. In 1981, Senator Sam Nunn (D, GA), the ranking minority member of the Senate Armed Services Committee, sponsored an amendment to the FY 82 Defense Appropriation Bill which required the Pentagon to report to Congress any major weapons programs which exceeded their March 1981 cost projections by 15% or more. Aegis was never affected directly by the Nunn amendment, but it was clear that Congressional Democrats

were seeking programs with which to embarrass their Republican opponents.

In July 1982, Representative Joseph Addabbo, the Democratic Congressman who chaired the House Appropriations Committee Defense Subcommittee, said in a published interview, "One thing we are insisting on . . . is dual source competition . . . when we have forced competition, where [the Defense Department] has been forced to second source, we're seeing dramatic decreases in price."³³ In 1980, less than a third of a national opinion sample considered the US equal to the USSR militarily; by the end of 1982, that number had nearly doubled. The changing attitudes toward defense, coupled with the impact of the recession, resulted in the Republicans losing 26 seats in the November 1982 House elections. Earlier that year, in August, the White House had barely turned aside a strongly worded nuclear freeze resolution debated in the House of Representatives. And that spring, the war between Britain and Argentina had fueled a major debate over the value of surface warships and the effectiveness of missile defense. The level of partisan conflict on defense issues was high.

Congress had also changed structurally. As Meyer himself noted, "There are thousands of people on the staff today. The seniority system has been badly disrupted." A member of the Navy's Office of Legislative Affairs believed that Meyer had not made the transition well: "Meyer's tactic *internally* had become one of buffaloing the opposition. That just backfired in Congress. Meyer angered staffers in the House Appropriations Committee, and they went after him."³⁴ This same observer believed that Meyer's flair for drama failed him in Congress after 1980. The Democrats were searching for targets, and Meyer's outspokenness and attachment to sole-source contracting made him a visible target.

Meyer responded to increased criticism by trying to use his contractors to monitor events in Congress. The result was a General Accounting Office investigation and some bad publicity. As one Navy Legislative Affairs Officer put it, "Congress had become impossible to predict. They were making their own rules." The result was an August 1982 report prepared by the House Appropriations Committee

³³ *Armed Forces Journal International*, (July 1982), pp. 8-9.

³⁴ Two members of the Navy's Office of Legislative Affairs were interviewed in 1985: CAPT John Fedor, USN, Deputy Chief of Legislative Affairs, and CAPT G.W. Dunne, USN, AEGIS Project Liaison Officer.

which criticized the stability and speed characteristics of CG-47 (*USS Ticonderoga*). Though it contained classified data, the report was leaked to *Defense Week*, and Representative Addabbo said afterward that the substance of the report's criticisms was correct.

Meyer was furious, but not just with the House investigators. He denied that there were any problems with CG-47's stability, but owned up to an error in judgment.

The issue of ship stability was never an issue. . . . It became an issue because of a serious error in judgment on my part, and it was related to my trusting some investigators who couldn't be trusted. Now, through the years, I don't know how many hundreds of investigators that project had. I had a GS-14 who spent his full time dealing with investigations. . . . We talked about waste, fraud, and abuse in government, but the waste, fraud, and abuse in investigations is incredible. . . . But we never backed away. I said "We have to believe that if some fella understands the facts the way you understand the facts that he will come to roughly the same conclusions." That case didn't work out—I let those guys get cast adrift when they should never have been let cast adrift, and they found themselves a cause. There were some critical facts concerning [*Ticonderoga's*] stability, but they weren't discovered by investigators. They were our own discovery.

Meyer also confessed to being puzzled by the zeal with which a few Congressional staffs pursued PMS-400.

I guess down in their hearts they thought they had something. They seemed thrilled by being able to have found something. It's a serious problem for the country. We're thrilled by some destructive, goddamn approach. . . . We seem determined to pick on each other. To this day, I don't understand the investigators' objective. To have had it leaked—and the report was classified at the time—was hard; it was a sad situation. It's hard . . . it's like when your wife chews your ass out. You feel taken advantage of, like nobody wants you, anymore. I don't think you ever totally snap back. Sooner or later you're ground down.

Paul Magliocchetti, of the House Appropriations Subcommittee staff and one of Meyer's critics, took a very different view: "Meyer got a blank check to the detriment of the rest of the shipbuilding program."³⁵

Magliocchetti said that he became suspicious of PMS-400's finances after one meeting with Meyer in 1982 when the Admiral acted "pompous and demanding." When the Navy ignored his first request for more information, Magliocchetti went to Addabbo for the

³⁵ Interview with Mr. Paul Magliocchetti, 30 July 1985.

authority and funds to conduct a focused investigation. What it revealed, according to Magliocchetti, was that PMS-400 had too much unobligated money, mostly in special reserve accounts controlled by Meyer. The reserve accounts existed to cover change orders in ship construction that could not have been anticipated in original estimates of ship cost; they were a necessary part of any major shipbuilding program. But the defense subcommittee believed they were too large in PMS-400; "a \$524 million cut in that money in FY 83 caused Aegis no problem, so there was obviously too much money there all along," according to Magliocchetti. There was also, given Addabbo's stated preference for dual source procurement, criticism of PMS-400's contracting arrangements with RCA and Ingalls.

House Appropriations Committee reports stressed the savings that could be achieved by competing the contracts for the ships themselves, the Aegis radars, and even the vertical missile launch systems which later Aegis ships would mount.³⁶ According to Committee sources, however, the real "driver" on the push to pressure PMS-400 into competing its shipbuilding contracts was John Lehman, President Reagan's appointee as Navy Secretary.³⁷

Former PMS-400 staff managers acknowledged that there was excess money in reserve accounts and slack in the sole source production contracts. But they explained that both were consequences of technological uncertainty and the limited size of PMS-400's staff.

RADM Meyer's real goal was not to field an improved AAW system; it was, instead, to revolutionize surface battle tactics of the Navy by the introduction of Aegis command and control systems. He had to play a game with the Navy and with Congress; pretend his system of battle management was conceptually developed when, in fact, it was still evolving. To keep it developing, Meyer needed to hoard money for contingencies; he also needed a sole-source relationship with RCA. Meyer also favored sole-source contracts in systems acquisitions

³⁶"Department of Defense Appropriation Bill, 1983," Report of the Committee on Appropriations, 97th Congress, 2nd Session, No. 97-943 (Washington: 1982), pp. 140-1.

³⁷According to John Landicho, Senior Associate Director of the National Security Division of the General Accounting Office, "the Assistant Secretary of the Navy, Shipbuilding and Logistics, stated that cost was not a deciding factor in the Secretary of the Navy's decision" to recruit a second source for producing the AEGIS system. Memo B-221141, 2 December 1985, from Landicho to Senator F.R. Lautenberg, and Representatives James Courter and James Saxton. PMS-400 was at that time resisting the effort to recruit Sperry Corporation as a second source.

and ship construction because PMS-400 would never have enough staff to manage second sources. As one former PMS-400 staffer said, "It was competition vs. control. We couldn't have both." Meyer wasn't insensitive to cost; he was incensed when costs exceeded reasonable estimates. But he believed that PMS-400 would lose control of the situation if too many contractors were involved.

PMS-400 was forced to give up its sole-source relationship with Ingalls, but Meyer gave in only reluctantly. As he noted:

We delivered a war machine that far exceeds what we were supposed to deliver. We still got people around who say it ain't good enough. But, damn, it's a lot better than what it was, and the ability to do that came from having the money so that you could adapt and seize opportunities as they came by. Good budgeting allowed us to save money, and our 'free money' for opportunities came from that saving. We had everybody in the goddamn project on a budget. It's the job of the manager to keep people to their budgets. Everybody's got to keep budget because the one contract every Program Manager's got is with Congress. *Ticonderoga* was on-time and on-budget. That's the way we're supposed to do things around here. They can harp all they want about there being too much money in Acgis. I say that's jealousy.

However, as a member of the Navy's Legislative Affairs Office suggested, there *was* more to it than that. Before John Lehman became Navy Secretary, the Navy rarely went to Congress with a clear, long-range strategy, and important Project Managers were given the freedom to develop their own relationships with members and staffers in Congress. Lehman changed all that. By 1982, the Secretary was acting on the basis of a planned, comprehensive legislative strategy, with clear goals and priorities set and enforced by his office. As one member of Lehman's staff observed, "the mouthpiece has become the decision-maker." An inevitable consequence of Lehman's assertiveness was a clash of his perspective (with its emphasis upon building *numbers* of ships) with Meyer's (with its bias toward changing the *quality* of battle management). Several serving Navy officers claimed in off-the-record talks that this conflict was behind Meyer's failure to win a third star and advance to the position of Chief, NAVSEA.

PMS-400 weathered the criticism of CG-47's stability and handling but not without some high-level help. CNO, ADM James Watkins, wrote a letter to Congressional Authorization and Appropriations Committees in September 1982, explaining that "the exchange of technical data with the investigators . . . was deficient, thus not permitting them to correctly judge stability and mission

effectiveness."³⁸ But Watkins would have to defend CG-47 again. Aegis had drawn Congressional and press fire and the hunt was on for additional problems. For example, stories about the leaked August 1982 House Appropriations Committee report were carried in all major national newspapers; the Navy's official, point-by-point response to the report was published at the end of the month, but only in *Navy Times*.

In 1983, the newspaper headline war heated up again. CG-47 was put through qualifications trials that April. That summer, Representative Denny Smith (R-Oregon), a frequent critic of high-cost military procurement programs, alleged that CG-47's Aegis combat system had failed operational evaluation. His criticisms were echoed in the Senate by Gary Hart of Colorado, a candidate for the Democratic Party's nomination for President. As Senator Hart told *The Wall Street Journal*, "Do we have a testing and reporting system that is fundamentally dishonest?" To head off speculation, the CNO acknowledged that there had indeed been software system failures in the April trials and he pledged further tests in September.

After the September 1983 tests, both Watkins and Secretary Lehman wrote to Representative Smith, assuring him (as Lehman did on 11 October) that "Aegis is the most carefully tested combat system ever built." But Smith did not stop his criticism of Aegis. That winter, he found an ally in Senator Charles Grassley (R-Iowa), a member of the Senate Armed Services Committee. In February 1984, Grassley grilled Secretary Lehman and CNO Watkins on CG-47's performance. The Navy Secretary accused Grassley of "grandstanding" and said that CG-47 was performing splendidly off the Lebanese coast in her first tour overseas. One week later, unnamed Pentagon and Congressional sources told *The Washington Post* that the Under Secretary of Defense for Research and Engineering had informed the Secretary of Defense that Aegis had serious design problems, and the Secretary of the Navy admitted to reporters that "actual missile kills . . . have not been that impressive." At the same time, Secretary Lehman officially (and privately) directed PMS-400 to supervise "a fully challenging test series," which it did with CG-47, 23-29 April 1984, near Puerto Rico. ADM Watkins praised the results of the trials

³⁸ ADM Watkins' letter is quoted in *Sea Power*, published by the Navy League of the U.S. (October 1982). See also, "Navy Develops New Plan for Aegis Weapon Tests," by E. Kozicharow, *Aviation Week* (20 February 1984); "U.S. ships Reported to be Threatened," by Fred Hiatt, *The Washington Post* (8 February 1984, p.4); and "Problems Persist in the AEGIS Ship Defense," also by Hiatt, also the *Post* (15 February 1984, p. 4).

at a public press conference, and the May 1985 Naval Institute Proceedings carried a glowing description of the Aegis system and also praised the performance of CG-47 during the ship's tour of duty off of the Lebanese coast the previous fall.³⁹ A later issue of the same journal, however, carried a long letter from an officer who claimed that the ability of CG-47's radar to monitor contacts against the backdrop of the Lebanese coast had been exaggerated. The ship had been approached by a light plane while patrolling near Beirut's harbor, and, by his account, CG-47 never detected it. The question of Aegis' operational performance was therefore left somewhat unresolved.

RADM Meyer left PMS-400 in August 1983 and became NAVSEA Deputy Commander for Combat Systems (NAVSEA-06). He was replaced by his protege and former Deputy, RADM D.P. Roane.

In the spring of 1985, the American Society of Naval Engineers awarded Meyer its prestigious Saunders Award for Achievement in Naval Engineering. Meyer had won the Saunders Award in 1977, and the Society's decision to honor him a second time was widely regarded in the naval engineering community as a signal to Navy Secretary Lehman to give naval technical managers more credit. As Meyer said when he accepted his second Saunders Medal, "Maritime power and naval victories are founded on the drawing boards of the engineers."

In September 1985, NAVSEA-06 was given control over the expensive and sophisticated SUBACS (for Submarine Advanced Combat System) Program. This decision appeared to be a major victory for Meyer. SUBACS was behind schedule, over budget, and the object of severe Congressional criticism. Rumors that Meyer would be pressured into retirement appeared unfounded. Late that same month, however, the Navy announced that Meyer would be replaced as head of NAVSEA-06 and then made Special Assistant to the Chief, NAVSEA. In early November RADM Meyer announced his December retirement.

Revisiting The Issues

To bring Aegis from its conceptual stages to fleet service, ADM Meyer had to overcome enormous problems. Foremost among them were:

- Convincing Congress, OSD, and the CNO that Aegis was necessary, technologically feasible, and affordable and then maintaining

³⁹ "The *Ticonderoga* Story: AEGIS Works," *U.S. Naval Institute Proceedings*, May 1985, pp. 118-29.

program credibility to ensure system survival over the twenty-odd years from system definition to fleet entry.

- Overcoming aviation community recalcitrance to support a new capability which they believed would downgrade or eliminate their traditional mission of Battle Group protection.

- Weathering the heated debate between nuclear power advocates and supporters of a high-low ship mix centered on hull design and ship propulsion which threatened to terminate the Aegis program altogether.

- Overcoming organizational problems over control of Aegis including shipboard weapons systems requirements and ship class and hull design that were initially under separate and competing offices.

- Maintaining continuity in contractor technical, analytical and production support in an environment increasingly calling for competitive contracting so that system requirements could remain based on operational performance goals and contractors could be disciplined with respect to attaining project milestones.

- Selling Aegis as a counter for the intermediate-range AAW threat—particularly in terms of its cost—when RADM Meyer envisioned Aegis from the outset as primarily a Battle Force integration system.

While other obstacles also had to be overcome, these impediments were both formidable in nature and exacerbated by a strategic culture within the Navy that remains inimical to *revolutionary change*. Admiral Meyer recognized that the only way to achieve integrated Battle Group AAW defense was with a system which inherently possessed the reaction time to effectively deal with the saturation, high speed, low flyer threat complemented by a battle management architecture which would permit the operator to exploit the system's capabilities. Battle management automation was key because without it the Aegis systems engineering success could never be utilized to its potential. However, such a revolutionary change in the way the Navy fights could not be "sold" in the early days and Admiral Meyer brilliantly camouflaged his true objectives under the umbrella of an intermediate AAW defense system for which a clear requirement had been established.

While Admiral Meyer's ability to promote Aegis as a counter to the Battle Group intermediate-range AAW threat (rather than as a Battle Force integration capability) helped decrease intraorganizational hostility from the TACAIR community, aviators eventually recognized that the surface community would inevitably impinge on their roles and missions through a combination of battlespace management capabilities and improved surface-to-air and new land-attack cruise missiles. Meyer's ability ultimately to persuade that community that its role in Battle Force protection would actually be revitalized by Aegis technology proved critical to the program's overall success.

Similarly, maintaining credibility in Congress for roughly 20 years was no small undertaking. Debates over whether Aegis should only be incorporated on nuclear-powered ships, and over a high-low ship mix destabilized the Aegis system program in that it focused on considerations not relating to its necessary function and technological feasibility. Thus the Program Manager raised the program above internal Navy politics in order to maintain a constituency in Congress independent of other major fiscal concerns relating to naval issues in Washington.

The Aegis Program In Context

Without question the Aegis program must be judged an unqualified success. Aegis has brought *revolutionary technological innovation* to naval warfare through unparalleled Battle Force coordination—not to mention an *evolutionary technological innovation* to Battle Force air defense capability through improved detection, tracking and engagement of airborne targets. The question then becomes what accounts for the huge success of the Aegis program? Several of those close to the program interviewed for this study differ significantly in what they see as the key ingredient accounting for that success.

Vice Admiral James H. Doyle, former Deputy Chief of Naval Operations for Surface Warfare (OP-3), attributes the success of the program mainly to excellent organization and teamwork:

... [T]he point is that we had a strong Program Manager who was in charge of this program. We had a strong OP-03 organization with direct representation and we worked as a team with the laboratories and industry and later set up those various centers of excellence all over the United States to support Aegis. Finally, we had strong support over in the House Armed Services Committee, Research and Development Committee and particularly in Tony Batiste who was a strong supporter of the program and who supported getting ... the

up-front money that we needed and so on. So with that kind of support we beat down all the opposition. The other thing that you've got to realize is that Meyer had a wealth of technical expertise to call on and I had a wealth of operational expertise to call on and we all focused. When you talk about advocacy, I mean we were really advocates. . . . Meyer (and his officers) and I ([with] . . . Hank Mustin, Ted Parker and Pete Malone) . . . went out and actually designed the Combat Information Center out at the Applied Physics Laboratory along with the CG-47. Ed Carter was also with us. Our feeling was, from an operational point of view, that this system was going to be far more than just a last ditch gatling gun and there was a lot of confusion around about people who thought that that was all we were doing, you know—a last-ditch gatling gun against cruise missiles. They didn't understand or had no vision of the battle management aspect. So we thought it was very important that we design a CIC that had the capability, number one, to support the Commanding Officer; and number two to support the unit commander or Flag Officer on any staff in case he happened to be Alfa Whiskey [the Anti-air Warfare Commander].⁴⁰

Adelaide Madsen, former Assistant to Rear Admiral Meyer while he was PMS-403, attributes project success differently:

I think it was the individuals.⁴¹ Well—Admiral Meyer, no question. Everybody that I know that knows anything about Aegis would say that. . . . Well, as you know probably, he was a very skilled speaker. Unquestionably the best speaker. He was a skilled engineer, [a] well-trained technical person, . . . He was a good manager. He knew how to inspire people. And there were good people intensely loyal to him . . . Admiral Doyle was also a key player. . . . Now, if there were any other things that were essential to the project becoming a success, I think certainly this unique arrangement of having one manager responsible for the whole development—that was the ship as well as everything on it. It was very successful—but that may have been largely because of the particular individual that made it successful. It may be hard to find that, but, you see, even in *Polaris* that wasn't the case because Rickover was in charge of the submarine development and Raborn the *Polaris* missile. I think, for the Navy at least, that having one manager that was responsible for the entire package was the key.⁴²

Perhaps the most important reason for success of the Aegis program can be found in the assessment of Rear Admiral Meyer himself:

⁴⁰ Interview with VADM J. H. Doyle, formerly Deputy Chief of Naval Operations for Surface Warfare (OP-03). (11 October 1993).

⁴¹ While singling out the primary leaders in Aegis development here, Ms. Madsen also indicates that highly motivated and capable individuals at *all* levels in the program were important to its success. She indicates that a lot of them were attracted to Aegis because it was something that had a good chance of success, and thus it was "an exciting place to be." She also indicates that "career sacrifices" were made by some associated with the project to stay with the Aegis program particularly RADM Meyer. (Madsen, *op. cit.*, in note 2).

⁴² *Ibid.*

Let's go back and review some of the characteristics of [successful Navy] programs. First of all, they were directed by engineering officers. Those programs were all directed by engineering officers with great and extended tenure. That's the important thing to remember. Second of all, they developed the confidence of the public; the public—*vox populi*—supported it.

I've run a lot of programs in my life. I've reviewed a lot of programs in my life both in my Navy life as a leader, and as a consultant. I have yet to find a single program in trouble for business reasons. Every program that I found in trouble can be traced to the technical aspects, or the engineering aspects. Now, the difficulty here, what would appear to be the dilemma, is that technical and engineering aspects, or troubles, manifest themselves on the fiscal schedule or the temporal schedule. So it would appear that if we just got better business management we'd solve the problem. . . . [I]f you want to find out whether a company is going bad, go to the Engineering Department, not the Production or Manufacturing Departments, go to the Engineering Department.⁴³

This study of the Aegis program bears out Rear Admiral Meyer's sentiments.

⁴³Interview with RADM Wayne E. Meyer, AEGIS Program Manager. (16 August 1993).

Chapter 4

WHO'S THAT TALL DARK STRANGER THERE?

Douglas V. Smith

As in that fabled ballad of TV, "Maverick" is his name. If one concept is firmly borne out in the cruise missile and Aegis case studies above, the Project Managers most closely associated with the success of their programs were intellectual, if not institutional, mavericks. The strategic culture of the naval, and indeed military, establishment is one which tends to inhibit *revolutionary technological innovation*, primarily by hindering career paths necessary to produce the technical foundations which will enable truly revolutionary engineering expertise. Thus, whether in areas of technology or doctrine, a nonconformist (with respect to innovative change) is required to overcome institutional biases.

This individualist, however, does not necessarily need to be within the naval establishment. On the contrary, this study has failed to confirm any of the three paradigms offered in Chapter 1 (Posen's innovation from outside the military through intervention of civilians; Rosen's top-down innovation through influence of senior military leaders; or Davis' bottom-up innovation through persistent efforts of mid-grade officers) as singularly accurate concerning the manner in which *revolutionary innovation* makes its way into the naval establishment. Rather, the diversity of potential sources of such innovation appears firmly established. For instance, the key mover in the cruise missile case was clearly William P. Clements, while CAPT (later RADM) Wayne Meyer fulfilled that function in the case of Aegis. Many others were indeed important—and perhaps critical—to the success of these programs, but these two individuals have been roundly hailed as the leaders without whom the respective projects would have floundered. As will be discussed later, however, the positions of these (and other) key figures in an organization(s) can profoundly impact the politics of the particular innovative venture for which they are advocates.

Technology for Technology's Sake

Peculiar as it may seem, many technological innovations within the naval—as well as all the other Service—establishments emanate from a desire to push technology to the limit (technology push) rather than to establish parameters for a widely agreed requirement and then foster innovative adaptations of technology to produce a feasible and acceptable approach to meet that requirement (technology pull). The role of doctrine is important to the relationship of these two different approaches to the incorporation of new technology in the military Services.

At the outset, this study offered as a central concern how innovations (either in technology, doctrine or both) trigger revolutions as well as how those innovations are recognized in the military. The cruise missile case provides an example of a *revolutionary technological innovation* unaccompanied by a concomitant doctrinal focus (ambiguity of mission actually enabled SLCM development which was advantageous to the Surface Warfare community through efforts of advocates of other than strategic uses of cruise missile capabilities). On the other hand, the Aegis case demonstrates the role of doctrine (albeit camouflaged by the Program Manager to decrease inter- and intra-Service opposition which would have otherwise emanated from the TACAIR community) in tailoring research to produce revolutionary Battle Force integration and management capabilities. The key to identifying the “trigger” for innovation in each case may well be the manner in which each program approached technology institutionally. In the cruise missile case, technology was unquestionably “pushed” to its limit without any real specificity as to its operational purpose; while Aegis technology was just as surely “pulled” to produce requisite capacity to meet a well defined and accepted perception of the future threat. Of the two approaches to *revolutionary* as opposed to *evolutionary technological advancement*, the “pull” approach appears more likely to produce a desired mating of technology and doctrine.

The concept of Cost Incurring Strategies also bears consideration as it relates to pursuit of technology for technology's sake. One of the prime factors in the survival of the cruise missile program at critical stages in its development was the manipulation of its perception as a strategic, and later theater tactical, nuclear weapon system which could be used as a bargaining chip for the SALT negotiations. Instantly, cruise missiles became a cheap offensive

capability which would tremendously exacerbate the Soviets' counter-targeting problems, thus necessitating them to allocate scarce resources to *defensive* military capabilities. Even without an overall strategy or refined doctrine for cruise missile employment, United States' leadership, by pushing US technological superiority to its limit, was able to elicit a desired defensive reaction from the Soviets, which in turn limited their ability to pursue *offensive* weaponry. Thus the role of "technology push" undoubtedly has its place in achieving political objectives through measures short of war. Even so, the cruise missile case demonstrates that such strategies are generally peripheral considerations. Most of the motivations associated with cruise missile technology and the politics supporting them were unconnected with the key objective of "trumping" the Soviets.

The Aegis case, on the other hand, demonstrates the benefits of sculpting or tailoring technology ("technology pull") by deliberately limiting and subordinating a system's possibilities to required applications. Originally intended exclusively as a *defensive* system, Aegis' value in eliciting a Soviet "cost-incurring" response was undoubtedly seen as minimal. Thus, even though the ultimate derivatives of the Aegis system—potentially including inter-atmospheric ballistic missile intercept—and supporting doctrines now indicate otherwise, Aegis was not at its inception a likely candidate to involve a costly enemy response to US technological superiority. It must then be inferred that advocating technology for technology's sake in a program, which may be advantageous when dealing with *revolutionary offensive technology*, may be considerably less advantageous when dealing with *revolutionary defensive technology* in terms of likelihood of overall program success. On the other hand, "technology pull" definitely appears to pay dividends in terms of producing a more parallel advancement of technology and doctrine than does "technology push."

Military Culture and the Element of Risk

The military has often been criticized by historians for planning, training (even desiring) to fight the last war. Military culture, if one agrees that there is such a thing, reviles against unnecessary risk. As was established in Chapter 1, however, some commentators, such as Vincent Davis, maintain that technological innovations are not generally driven by a grand strategy, but reflect the belief that the genesis of innovation is the desire to find a better way of doing a

mission already inherent in the Navy or established by a current national strategy.¹ The cruise missile case would tend to bear out Davis' observations. The Aegis case, on the other hand, only supports Davis' position to a point. As originally envisioned, Aegis and associated technological innovation were driven by an old strategy necessitating intermediate-range counter-air capacity. However, Aegis so revolutionized the way in which warfare at sea could be conducted, it permitted the Navy to alter its Maritime Strategy to meet the new challenges of littoral warfare detailed in . . . *From the Sea*. By "pulling" technology to find a better way to accomplish a mission inherent, in current Navy strategy the Navy was able to move briskly into a new strategic environment. Meyer's influence as a maverick and intellectual nonconformist enabled the Aegis program to achieve *revolutionary* innovation from within the Navy.

It should be observed that Davis' theory is not universally accepted. For instance, three very different strategies for overcoming the protracted static trench warfare of the First World War emerged in the period after 1918. The Germans, expanding on successes achieved at the end of the War through maneuver warfare, came up with the *Blitzkrieg*. Contrary to the position of Barry Posen outlined in Chapter 1,² most observers of the German inter-War military resurgence would agree that, even though tanks and aircraft had been utilized in the First World War, technological improvements during that period resulted from a redefinition of their utility and from development of *Whermacht* doctrine (based primarily on rapid maneuver of well-supported infantry forces) rather than vice versa. Similarly, the British sought to obviate trench warfare through strategic bombing and the French sought to eliminate it by fortifying the Maginot Line. *All* managed to come up with revolutionary strategies—which were primarily driven from within the military rather than from without—with concomitant revolutionary technological breakthroughs, but *all* were equally shortsighted in realizing the ultimate limitations of the new ways of conducting warfare they had devised. For the Germans, *Blitzkrieg* broke down when the necessary concentration of forces required for its success could not be achieved. For the British, inaccuracies in targeting and unrealistic

¹ Vincent Davis, *The Politics of Innovation: Patterns in Navy Cases*, Monograph Series in World Affairs, Vol. 4, No. 3 (Denver: University of Denver, 1967).

² Barry R. Posen, *The Sources of Military Doctrine: France, Britain, and Germany between the World Wars* (Ithaca: Cornell University Press, 1984).

assessments of the fragility of will of the German population led to unexpected protraction of the Second World War and the requirement to return land forces to Europe. For the French, the Maginot Line was simply bypassed, however unexpectedly, by the Germans in their end run through the Ardennes forests. The point is that, whether as Posen believes doctrinal innovation is imposed on the military and technological innovations must be pushed from inside,³ there is certainly a risk associated with relying on strategic and technological innovation to overcome the military deficiencies of the last war—not to mention the very real uncertainties of the next war. Military culture in general, and naval culture in specific, has good and historically documented reason to hedge against the risk inherent in “fixes” that rely on fundamental departures from the normal way of doing things. Perhaps Kurth provides the most useful insight when he offers that, in the case of the Navy, “the politics of *incremental innovation* are comparatively free of conflict . . . [while] the politics of *innovative departure* are likely to be complex”⁴ and therefore the Navy/military are much better at the former than the latter. One last insight here is that Kurth’s observation may be significantly more applicable to “strategy and technology push” than to intelligence-based “strategy and technology pull.”

One of the most significant inhibitors to the programs considered here was the tendency of the Services to reject applications not under their control. This aspect of military culture is highlighted in the Air Force recalcitrance at accepting the Office of the Secretary of Defense (OSD) designation of the Navy as the Executive Agent for development of all variants of the cruise missile. It also represents a significant probable impediment to all future programs involving shared technology between the Services, and may become a phenomena of primary concern as the current Administration strives to decrease shared Service missions and reduce military expenditures through increased commonality of weapons systems.

Inter-Service Rivalries

Aside from the fierce struggles to lead programs that affect Service futures, especially if those programs have the potential to change

³ *Ibid.*

⁴ Ronald J. Kurth, *The Politics of Technological Innovation in the United States Navy*, doctoral thesis (Cambridge: Harvard University, June 1970), p. 4.

traditional roles and missions, inter-Service rivalry plays a dominant role in the ultimate success or failure of almost any major program. In the competition for scarce monetary and materiel resources, the Services—even in this era of jointness—view procurement as a zero-sum game. The competition for roles and missions takes on an even uglier bent. As evidenced in the cruise missile case, *any* form of cruise missile with even a quasi-strategic role was seen by the Air Force as potentially encroaching on their primary mission, and threatening to the future of their manned bomber force. Thus, inter- and even intra-Service competition for existing roles and missions caused the Air Force to attack the naval program even before its mission could be clearly defined and without regard for the potential importance of that mission to overall national strategy.⁵

While the Aegis program was not inundated with inter-Service rivalry over roles and missions, it most surely was subject to such rivalry concerning allocation of national resources. Hence prioritization of naval missions with respect to those of the other Services became an important consideration in maintaining extra-naval credibility for Aegis in competition for funding.

While there is no way to preclude rivalries of this type, overcoming them remains a critical element of program success as long as individual Services retain the responsibility for manning, outfitting and training their respective forces. The problem is exacerbated for programs involving *revolutionary* strategies, doctrines or technologies since military strategic culture generally opposes them because of their inherent risks.

Navy vs. Navy

Intra-Service rivalry is every bit as much of a potential program impediment as that between the Services. Had it not been for Department of Defense and Executive Branch advocacy for the strategic role of cruise missiles, as well as that of the Navy submarine community, the naval variant of those missiles could very easily have succumbed under the intense attack from TACAIR. The TACAIR community was even more difficult to assuage in the case of Aegis since that system was seen as a clear threat to the traditional role of the aviation community in Battle Force anti-air interdiction. The motivation for

⁵ Intra-Service objections were raised by the TACAIR community for the same reasons.

attack on the *revolutionary* technological advancement of another component of the same Service stems from the reasons which promote inter-Service rivalry—competition for resources, particularly where there is an interrelationship of competing or similar systems, and perceptions of threat to established missions and doctrine.

Although it has been argued that doctrinal innovation is imposed on the military while technological innovation must be pushed from the inside,⁶ the nature of intra-Service rivalry would tend to retard the more radical forms of technological innovation. As a result, military organizations are much more likely to foster incremental changes to the way they are already approaching warfare requirements through adaptive technological innovation than revolutionary departures from their accepted norms. Just as individuals and not organizations are the innovators, arguments opposing innovations are likely to be personalized since they will generally come from those whose place in the overall organization is threatened.

Barry Posen argues that organizations innovate for several reasons: because of failure (such as defeat in the last war in the case of the military); when they are pressured from without; and when they desire to expand.⁷ In the aftermath of the Cold War and in view of the success of *Operation Desert Storm*, Congress will not likely support innovative systems which attempt to strengthen any segment of the Armed Forces in response to an increasingly threatening adversary. Therefore, the first of Posen's reasons for innovation is dormant for the present. His second reason most assuredly applied to the cruise missile program, but not to Aegis. It may very well be operative, however, with respect to programs in the near-term. Posen's last reason for organizational innovation may well describe what eventually happened in both the cruise missile and Aegis cases, but expansion of a role or mission was not a significant motivator in either case at the outset. In this period of relative austerity, expansion would likewise seem an unrealistic motivational force for innovation. Thus one might argue that there is limited expectation for technological innovation in the current situation, and that, lacking a clear emerging threat and given the tendency of Service communities to staunchly defend their roles and missions, a period of stagnation in naval—and indeed all types of military technological—innovation could be expected. Certainly historical parallels when advances in

⁶ Barry R. Posen, *op. cit.* in note 2.

⁷ *Ibid.*

strategy and operational art failed to follow military successes could be drawn. Unlike most other nations which view war as a continuation of policy by other means, Americans tend to view war as a failure of policy. As a result, after the successful conclusion of war the United States invariably attempts to return to its "normal state"—concentration on policy emanating from a basic state of peace. As a result, throughout our history—after the American Revolutionary War; the Civil War; the First and Second World Wars; Korea; the Cold War; and *Operation Desert Storm*—this nation has entered a period where it has cut forces, drastically decreased defense expenditures and diminished concentration on improving our ability to conduct war. Having never lost a war with the exception of the Vietnam conflict, there has been little motivation for advancing strategy and operational art immediately after signing a favorable peace treaty. Oddly enough, one might argue that the revolution in military affairs we are now experiencing emanated from the first real period of introspection by the US military following our Vietnam experience.

At first glance it might appear that the current situation would produce a most lucrative potential for doctrinal innovation. But if Posen is right in asserting that innovations in strategy and doctrine are normally imposed on the military by civilians, there are indications that this may not happen. National security strategy is simply not the focus of the current Administration. Of note, only seven of sixty-six men in top positions in the Administration have ever served in the military⁸ and only 18.2% of the House freshmen and three of the fourteen freshman Senators elected in 1992 have had prior military experience.⁹ Consequently, there is precious little experience to create a groundswell for doctrinal innovation either at the White House or on the Hill and the opportunity to critique and perhaps refocus our military strategy and doctrine may well be lost.

It is also worth noting that both the cruise missile and Aegis programs were in service for significant periods before follow-on doctrinal innovation appeared. Fear of impinging on the roles of other naval components or other Services may well account for this lackluster approach to new and better applications for emerging

⁸ Charles Peters, "Tilting at Windmills," *Washington Monthly*, July/August 1994, p. 4.

⁹ Robert J. Bresler, *The New Freshmen, the 103rd Congress, and the National Defense: Separating Rhetoric from Reality*, (Carlisle Barracks: U.S. Army War College, March 1993), p. 12.

technology. Hopefully the recent establishment of Naval and Joint Doctrine Commands will overcome traditional inertia.

Technical vs. Managerial Competence in Program Management

The most significant revelation of the cases considered herein is the necessity for technical competence on the part of the Program Manager and his top advisors for a program to be a success. Invariably, management is the one area which comes under scrutiny when program milestones are not achieved or cost overruns occur. As RADM Meyer pointed out in the last Chapter, almost without exception program troubles can be traced to technical problems. Just as invariably, however, the top leadership of Navy (and other Service) programs which are not meeting expectations is likely to be replaced by "better managers" not better engineers. The value of technical competence in Navy program management cannot be overemphasized, and any measures that can be taken to focus on the technical mastery of potential Program Managers should be institutionalized in the Navy.

Personalities are also critical. Both Admirals Locke and Meyer were extremely astute in their handling of roadblocks to program success and their dealings with Congress, the Executive Branch and intra- and inter-Service rivals to their programs. With less advocacy for their programs or less ability devising strategies to overcome recalcitrance, it is doubtful that either program would have succeeded. Though it may be impossible to institutionally foster such amorphous qualities as personality and leadership, ensuring career paths are available for officers identified as technically suited for leadership in mainstream acquisition programs could pay significant dividends.

Outside Program Manipulation

All programs are subject to outside manipulation and are likely to undergo it in order to survive in a fiscally constrained environment. Cruise missiles and Aegis were no exception. The cruise missile program was manipulated by Congress and the Executive Branch to serve as a bargaining chip for SALT negotiations and later as a low-cost alternative to complicate Soviet targeting. The Aegis program was subjected to cost and viability decisions tied to Congressional desire for a surface nuclear power program. In both cases, these external considerations (basically unrelated to the programs themselves)

were overcome—not in small part due to the demonstrated technical excellence of the weapons systems created by the programs and the advocacy of the Program Managers. Project Managers ran a counter-manipulation program to align pro-Program forces against protagonists to ameliorate the negative impact of the latter at critical stages of program development. It may, however, be considerably more difficult in the future for truly revolutionary technologies to make their way into the military. As Posen offers, “[c]ivilians do not necessarily have the expertise to directly change military doctrine in order to bring it into conformity with an overall grand strategic design. They must rely upon mavericks within military organizations for the details of doctrinal and operational design.”¹⁰ In that members of Congress and the Executive Branch are coming into office without military experience in increasing numbers, and considering the fiscal restraint under which the Services must operate in the post-Cold War period—particularly without the emergence of a credible threat to national interests which requires a grand strategy to counter it—the potential for subversion of costly technical programs by relatively uninformed opponents could increase significantly. The importance of a “maverick”—an intellectual nonconformist with strong technical, leadership, organizational and interpersonal skills—will be even more central to the success of future Navy programs than in the cases presented here.

Innovative Programs Outside the Military Mainstream

Like most successful programs that have truly revolutionized warfare on, under or from the sea, cruise missile and Aegis technology bases existed outside the mainstream of the Navy. They represented concepts and ideas that were innovative to the extent that they demonstrated potential for disenfranchising other Navy communities' reasons for existence. No truly revolutionary technology can hope to be welcomed enthusiastically throughout an organization as conservative and convinced of its past successes as the Navy without first creating a broad-based constituency which acknowledges the requirement to adapt for survival. The vehicles for creating such a constituency are strategy and doctrine, and the impetus for change is normally lack of success in war. If one thing stands out from the cases presented here, it is that doctrine almost

¹⁰Posen, *op. cit.* in note 2, pp. 174-5.

invariably lags behind technological innovation. Only in the case of "technology pull" associated with Aegis was doctrine developed in a more nearly parallel fashion—yet it still lagged. The increased recent interest in the development of doctrine on the part of the Navy is indeed encouraging, but, once again, even if such documents as . . . *From the Sea* create an environment for "technology pull," innovative Navy programs are likely to remain outside the military mainstream. Outstanding entrepreneurship on the part of the managers of such programs will continue to be a critical hallmark of their success.

Innovative technical programs of value to the Navy are also more likely to emanate from the civilian sector as the Services pare down in personnel strength in the aftermath of the Cold War.¹¹ Technology applications, unconstrained except by their ability to produce profit, which are fostered by engineers and managers leaving military service can definitely play a part in enhancing the military posture of the United States. But the defense industry has slowed the hiring of such individuals. Innovative ways to acknowledge and encourage technological breakthroughs of military utility could provide an avenue for development of programs which would otherwise be hard-pressed to survive in the current environment.

The key to success in future programs would appear to be concentration on technical as opposed to managerial competence in program oversight, creation of a "track" to develop career paths for "mavericks" to ensure that they will be rewarded rather than ultimately punished for their dedication to technology competence, and concentration on as near to parallel development of doctrine and technology as can possibly be achieved.

¹¹ As one article noted that "the biggest winners may be outside the defense industry altogether. 'The fields of technology that are most important to the Defense Department today,' Defense Secretary William Perry said recently, are 'semiconductors, computers, software and telecommunications.' Defense analysts agree." (Thomas E. Ricks and Roy J. Harris, Jr., "Marshall's Ideas Help to Change Defense Industry," *Wall Street Journal*, 15 July 1994, p. 1).

CHAPTER 5

CONCLUSIONS

Bradd C. Hayes

It's hard to forecast, especially about the future.

— Casey Stengel

The goal of this effort was to study how innovations trigger revolutions as well as how those innovations are recognized and implemented in the military. Whether one uses Andrew Ross' definition of military technology, which included both the artifacts of warfare and the organizational processes by which they are employed or Stephen Rosen's more restrictive, doctrine-oriented, definition, both the Tomahawk and Aegis systems qualify as major innovations. They also satisfy the eight "iron laws" proposed by Anthony Cordesman which he considers necessary for a technological innovation to make a lasting contribution, namely:

- An effective concept of operations for employing both Tomahawk and Aegis on a force-wide basis, and in effective combined arms and combined operations, has been developed.
- Proper training both in operating the systems and integrating them into full scale combat operations is in place.
- Sufficient funding has been provided to ensure sustainability in combat, and the necessary command, control, communications, intelligence and battle management (C³I/BM), targeting and damage assessment assets have been procured.
- Suitable power projection, logistic, service support, and combat support capability is in place to support both systems.
- Suitable maintenance and repair capability for Tomahawk and Aegis exists.
- Both systems seem to be immune to cost-effective countermeasures, and unexpected obsolescence within their required service lives.

► Adequate skilled manpower to use both systems, from the operator to the high command level, is available.

► Reorganization, retraining, and adjustment of concepts of operations, technology mix, and force mix to suit specific contingencies, threats, and allied forces have taken place and continue to evolve.¹

Tomahawk and Aegis now allow surface combatants to operate more independently across a broader range of tasks than ever before. Recent war games have witnessed joint task force commanders demanding the early arrival of TLAM and Aegis ships (especially those programmed to have theater ballistic missile defense (TBMD) capabilities), even if this meant departing ahead of and separate from their associated carrier.² This is a dramatic doctrinal change from the Cold War years when the inviolability of the Carrier Battle Group structure was chapter and verse of the Navy's operating bible.³

As a result of the extensive interviews and research which produced this study, a number of conclusions were reached.

CONCLUSION 1. No one theory of innovation proved dominant. To quickly review (and undoubtedly over-simplify) what those theories were, Posen concluded that innovation comes from outside the military through the intervention of civilian authorities; Rosen asserted it comes from within the military from the top down; and Davis asserted it comes from within the military from the middle up. Although undoubtedly true that the Navy, like most large bureaucracies, resists change, innovation does occur and no *single source* for it can be identified. In fact, if the case studies *proved* anything, it was that one can come closer to representing reality by combining portions of the three theories of innovation than by taking anyone of them alone.

¹ Anthony Cordesman, "Compensating for Smaller Forces: Adjusting Ways and Means Through Technology," *Strategy and Technology* (Carlisle Barracks, PA: Strategic Studies Institute, 1 April 1992), pp. 8-9.

² For example, see Bradd C. Hayes, et. al., *Issues Raised in The Secretary of the Navy Wargame 94*, Research Memorandum 1-94 (Newport: Naval War College, Strategic Research Department, March 1994), pp. 26-8.

³ Simply asserting that TLAM and Aegis permitted these doctrinal changes would be misleading since the end of the Cold War itself played a major role as well.

Posen. Three of Posen's hypotheses were supported by the case studies:

First, a technology that has not been tested in war can seldom function by itself as the catalyst for doctrinal innovation.

The Gulf War (which quickly followed the end of the Cold War), set the stage for a new vision of how maritime forces could be used. Tomahawk and Aegis were central in the discussions leading to the Naval Service's white paper, . . . *From The Sea*, and were indeed "catalysts for doctrinal innovation." They are among the high technology and smart weapons systems to which strategists refer when discussing the future of warfare.

Second, military organizations . . . learn about technology by using it in their own wars.

Much was learned about the performance, characteristics and reliability of Aegis and Tomahawk during the Gulf War (and others preceding it, e.g., the Tanker Wars during the Iran-Iraq War). Whereas the US was hesitant to use Tomahawk in retaliation for Libyan terrorist acts in the 1980s, it showed no such reservations when it retaliated against Iraqi terrorist threats to former President Bush following the Gulf War.⁴

[Organizations innovate] when they are pressured from outside. . . . [Civilian] intervention is often responsible for the level of innovation. . . .

Civilian intervention was instrumental in both the Tomahawk and Aegis cases; but of the two, the Tomahawk case provided the strongest confirmation of Posen's hypothesis. Without the support of Melvin Laird, William Clements, John Foster and other high-ranking civilians, the Tomahawk program would never have begun. The most interesting part of the Tomahawk story is that the version of the missile which has had a truly revolutionary impact (the conventional version) was proposed by Dr. Albert Wohlstetter, who was only in a position to influence decisions as a consultant on the

⁴ Rowan Scarborough, "Saddam behind Bush plot, Aspin says. Strike called appropriate retaliation," *Washington Times*, 28 June 1993, p. 1.

periphery.⁵ Posen also believes outside intervention is most effective when supported from the inside by a military maverick. As noted below, Meyer and Locke filled this role.

Posen proposed two other hypotheses about why organizations innovate which were not supported by the case studies. They were: as the result of failure; or when they desire to expand. It can be reasonably argued, however, that two case studies do not constitute an adequate data base from which to draw meaningful conclusions about unsupported hypotheses. Even so, one would have to strain at a gnat in order to find evidence of either of these hypotheses in the case studies presented. Aegis and Tomahawk, although developed following the failure of the Vietnam War, emerged as counters to Soviet threats and not from lessons learned during the war. And neither Aegis nor Tomahawk technology and doctrine were wedded into truly innovative applications until it became obvious that the military was shrinking, not expanding.

Posen also asserted that because of the process of institutionalization, innovation in military doctrine should be rare (doubly so because innovation increases operational uncertainty which is an anathema to the military). Kurth noted, however, that more innovation probably occurs in the military than for which most people give it credit (see below).

Rosen. Rosen noted that four themes dealing with the problem of military innovation emerged from his work and all four were supported to some extent by our case studies.

First, *innovation requires "a new theory of victory" which results in an ideological struggle within a particular Service.*

Rosen's hypothesis that a "new theory of victory" is necessary for doctrinal innovation, although arguable, is generally supported by the case studies. Both Tomahawk and Aegis helped usher in a new vision of naval warfare and their roles in that "new theory of victory" have continued to expand. Although the Naval Service was considering making major doctrinal changes prior to the end of the Cold War, that event forced the nation to develop a new theory of victory and undoubtedly accelerated the process.

⁵ Interview with Dr. Albert Wohlstetter, 18 September 1993.

But as Rosen asserts, innovation results only if the new theory of victory results in an intra-Service ideological struggle. The implication is that the change need not affect the nation's grand strategy. For example, the emergence of the *Maritime Strategy* during the height of the Cold War was considered by some a major innovation yet it fit within a well established Cold War grand strategy. However, the Maritime Strategy did provoke much discussion, both in and out of the Service. James Lacy argued in his study of naval strategy that grand strategy rarely brings about this ideological struggle. He states that "more commonly, strategy has played no central role other than to provide a post hoc justification [for weapons technology development]; and, on occasion, the relationship is so fundamentally circular as to defy after-the-fact justification."⁶

Thus, the Services should be encouraged to continue to promote their own visions of the future of warfare, such as those contained in the Air Force's *Global Reach—Global Power* and the Naval Service's . . . *From the Sea* white papers. These thought pieces have a much greater chance of stirring intra-Service discussion and innovation than a strategy formulated by the National Security Council.

Second, *emerging from this ideological struggle must be new, concrete and critical tasks.*

These systems did result in new, critical tasks which affected Service behavior. When Admiral (then Vice Admiral) William Owens commanded the Sixth Fleet, he used the capabilities of Aegis and Tomahawk to form and exercise Maritime Action Groups (small task groups operating independently from the Carrier Battle Group). Although hunter-killer groups (HKG), surface action groups (SAG) and the like have a long history, Maritime Action Groups differed significantly in both their purpose and operations (as a result of having Aegis and Tomahawk available).⁷ Whereas HKGs and

⁶ James Lacy, *Within Bounds: The Navy in Postwar American Security Policy* (Alexandria, VA: Center for Naval Analyses, July 1983), p. 32.

⁷ A similar tactic is apparently being considered for US naval forces stationed in Southwest Asia. "Earl Rubright, the science adviser to the U.S. Central Command, which oversees operations in the Mideast, visited the Pentagon in May to tell a group of senior Navy officers how six destroyers and cruisers could fire enough missiles to destroy a division of 750 enemy tanks and still have enough left to ward off an enemy aircraft or missile response." [Thomas E. Ricks, "How Wars Are Fought Will Change Radically, Pentagon Planner Says," *Wall Street Journal*, 15 July 1994, p. 1].

SAGs were temporarily dispatched to complete specific tasks then expected to rejoin the Carrier Battle Group (CVBG), the increased capabilities inherent in MAG ships allowed them to operate independently from the CVBG.

Third, a new distribution of power within the Service must emerge from the ideological struggle as well as new paths to power (i.e., Flag rank).

Command of an Aegis ship has in fact become the holy grail for surface warfare officers and is viewed as one of the surest paths to Flag rank in their community.⁸ One of the most recent Flag selectees was serving as the Program Manager for Fleet Introduction/Lifetime Support for Aegis when selected and had previously been the Aegis Combat Systems Manager in NAVSEA.⁹

Fourth, these new career paths are created from within, by senior officers currently holding power, rather than being forced upon the Service from outside.

This is certainly true in the case of Aegis cruisers and destroyers. But even in the Tomahawk case the support of senior military officers like Admirals Zumwalt, Long and Doyle, was essential for the program to be sustained. Once Tomahawk was introduced to the fleet, and especially following the Gulf War, assuming command of a Tomahawk-shooter was considered an excellent career opportunity. Land-attack became a critical mission for the submarine community following the collapse of the Soviet Union and the concomitant reduction in the submarine threat.

Rosen missed the mark, however, when he discounted the influence of external factors as well as the importance of organizational mavericks.

Davis. Davis' research suggested that innovation in the Navy does not come from the top but comes from the personal initiative of middle grade officers. Although our case studies did not support that conclusion, they did strengthen his hypothesis that innovators share certain traits.

⁸ Traditionally, command of either a cruiser or destroyer squadron was considered an important qualification for selection to Flag. Of the nine most recently selected surface warfare Flag officers, six fit into this category. [*Surface Warfare*, March/April 1994, pp. 20-1.] Since Aegis cruisers and destroyers are the newest ships in the fleet, they are considered "plum" commands.

⁹ *Ibid.*, p. 21.

Innovators recognize, rather than invent, innovations and possess unique technical expertise in the area of innovation.

Neither Meyer nor Locke invented any portion of the systems they managed. Both, but Meyer in particular, had the technical backgrounds necessary to understand and appreciate the challenges and possibilities they faced.

Innovators form informal horizontal working alliances to promote the innovation and eventually gain vertical support from influential senior officers, who themselves may form informal horizontal working alliances.

Without the advocacy and nurturing of a mid-rank zealots, such as then-Captains Locke and Meyer, the Tomahawk and Aegis programs would have been stillborn. Meyer, in fact, epitomized Davis' innovation advocate, who is an officer in the broad middle ranks (O-4 to O-6); is seldom the inventor but possesses unique technical knowledge; is a passionate zealot; and seldom pays attention to the ways his efforts influence his personal career. Meyer also used the advocacy techniques identified by Davis with the exception noted below.

Davis' hypothesis concerning the reluctance of naval innovators to seek outside support (i.e., outside the Department of the Navy) was simply not true in the cases studied here. Meyer, in fact, nurtured supporters wherever he could find them (especially outside the Department of the Navy). In the Tomahawk case, Locke also found his strongest support outside the Department of the Navy. While fostering these extra-organizational allies was essential to program success, it almost guaranteed limited promotion opportunities for Meyer and Locke. This was partially because the Navy's best known zealot, Admiral Hyman Rickover, had fostered such strong support outside the chain-of-command that the Navy had essentially lost all influence over him. Eventually Rickover's personality became inseparable from his programs and detractors could then attack either Rickover or his programs and accomplish the same thing. Having two or three Rickovers to deal with was likely more than the hierarchy could bear.¹⁰

¹⁰ Rickover found his power base in Congress. Locke never developed a Congressional power base because he found sufficient support in OSD. Meyer, who worked hard at fostering Congress, never gained the type of support garnered by Rickover.

CONCLUSION 2. *Technology development precedes doctrine development.* As noted in the introduction, there are those who not only believe they can, but must, develop doctrine ahead of technology. Hap Arnold believed that a force "which does not keep its doctrine ahead of its equipment, and its vision far into the future, can only delude the nation into a false sense of security."¹¹ But nothing in our research leads us to believe that happens very often, if ever. The drive behind theater ballistic missile defense (TBMD) doctrine using Aegis ships comes about as close to parallel development of technology and doctrine as one can get. But even here, the technological base upon which TBMD is built was developed long before the requirement for a TBMD capability was even identified. As the US entered a new security environment, it was no accident that the *National Military Strategy* insisted that the "United States must continue to rely heavily on technological superiority [in order] . . . to maintain our qualitative edge. . . . [A]dvancement in and protection of technology is a national security obligation."¹² Charles H. Duell, Commissioner of the U.S. Patent Offices in 1899, could not have been further from the mark when he said, "Everything that can be invented has been invented."¹³ The military must guard itself against this kind of lack of vision.

CONCLUSION 3. *Programs that have the potential to be truly innovative will have a better chance of being fielded if promoted as evolutionary rather than revolutionary systems.* As Kurth concluded:

In reality, incremental innovation occurs at a high rate while innovative departure is still slow and difficult. The problem is that more rapid acceptance of radical innovation would require a change in basic service values and attitudes or require easier access to political arbitration. The services resist dilution of their ethic, and the public and political leaders are disturbed by inter-service and intra-service conflicts.¹⁴

¹¹ General Henry H. (Hap) Arnold quoted in Air Force Manual 1-1, *Functions and Basic Doctrine of the United States Air Force*, February 1979, 4-11, cited in Kenneth P. Werrell, *The Evolution of the Cruise Missile* (Maxwell AFB: Air University Press, 1985), p. 1.

¹² *National Military Strategy* (Washington, DC: Department of Defense, 1992), p. 10.

¹³ Quoted in an advertisement for "The Economist - A patently better idea," 1993.

¹⁴ Ronald James Kurth, *The Politics of Technological Innovation in the United States Navy*, doctoral thesis (Cambridge, MA: Harvard University, June 1970), p. 45.

One successful program manager, Stephen Hostettler agreed, "Evolution is always the best way to go in terms of getting the most for your dollar, the most capability for your dollar."¹⁵ Evolutionary change is also easier for the innovator. As Kurth notes, "[T]here is a much more comfortable existence within the organization for those who make the existing system work better rather than attempt its displacement."¹⁶ This is certainly not a new insight, Machiavelli wrote centuries ago that, "there is nothing more difficult to take in hand, more perilous to conduct, or more uncertain in its success, than to take the lead in the introduction of a new order of things, because the innovator has for enemies all those who have done well under the old conditions, and lukewarm defenders in those who may do well under the new."¹⁷ There are currently well placed military and civilian advocates of revolutionary changes in Service equipment and doctrine.¹⁸ Although nothing emerged from this study from which one could conclude that their approach is wrong, history reveals that they will have a difficult time selling their position.

As noted earlier, evolutionary innovation can lead to revolutionary changes. It is interesting to note, for example, that despite the dramatic changes ushered in by Tomahawk and Aegis, none of their advocates forecast the exact roles they would play. The Tomahawk was conceived as a strategic weapon and only developed over time into a tactical nuclear then conventional weapon. Aegis was promoted as a Carrier Battle Group anti-air warfare system but emerged (under Rear Admiral Meyer's careful guidance) as a battle management system which could eventually include a sophisticated TBMD capability.

CONCLUSION 4. *People, not organizational arrangements, make the greatest difference to innovation.* While organizational arrangements can place significant obstacles in the way of innovators, they cannot make pedestrian people creative. On the other hand, innovative people can generally overcome organizational obstacles. As

¹⁵ Interview with Rear Admiral Stephen Hostettler, USN (Ret.), 7 September 1993.

¹⁶ Kurth, *op. cit.* in note 14, p. 71.

¹⁷ *The Prince*

¹⁸ Ricks, *op. cit.* in note 7, and the Vice Chairman of the Joint Chiefs of Staff, Admiral William Owens has said, "It's a time you just can't iterate decisions. . . . You can't just gradually change." [John Boatman, "Jane's Interview," *Jane's Defence Weekly*, 23 July 1994, p. 32.]

Admiral J.D. Williams stated, "You can't design an organization for advocacy and innovation because bureaucracy will stomp it out every time. . . . I don't think good people worry about organization. Good people will do what's right independently of the organization."¹⁹ The next two conclusions are corollaries to this one.

CONCLUSION 5. *The best way for a large bureaucracy to foster innovation is to function like a small one.* As Albert Wohlstetter stated it, "Large organizations tend to be run by rules and there tend to be standard problems. Therefore, people who are working on something else seem to be beyond the pale. When you are working in a large organization, the important thing is that you really try to encourage simulating working in a small organization."²⁰ The Navy did this by establishing Program Offices which, in fact, became small organizations. The case studies indicate this is a good system if the Offices are given stable leadership. Locke and Meyer both had long leadership terms over their respective programs. The "Rickover syndrome," however, has prompted the Navy to routinely rotate program leadership. Kurth notes that by routinely rotating program leadership "the Navy incentive system exerts conservative control over innovation. Quantum-jump innovations, which may destabilize the organization, usually require a span of attention over a considerable length of time. Time required to sell the ideas in addition to developing them. . . . The length on the job for an innovative departure may be undesirable [for personal career development]."²¹

CONCLUSION 6. *True innovations (the marriage of both technology and doctrine) cannot generally be accomplished by a single individual, the mythical "man on a horse."* But innovation can be brought about by a small group of good people; or to follow through on the analogy, a "few good men and women in a wagon pulled by a man on a horse." As Admiral Joe Williams asserted, "A good man knows what a good man is. So, it's easy for a good man to surround himself with good men. And good men like to work for good men. A good man can recognize talent when he sees it. You

¹⁹ Interview with Vice Admiral J.D. Williams, USN (Ret.), 8 December 1993.

²⁰ Wohlstetter interview, 18 September 1993.

²¹ Kurth, *op. cit.* in note 14, p. 84.

don't ever make it on your own. You make it because of the people you pick."²²

By all accounts, Meyer's and Locke's leadership were essential to the development of their programs. Meyer, in particular, seemed to have developed a unique and effective leadership style. When Admiral Hostettler took over the Tomahawk program from Admiral Locke, he attempted to incorporate Meyer's style in his Office.²³ Thus, it was a conclusion of those interviewed that without the right project manager, no program will succeed. It depends more on the person in the job than on the organization. Said another way, "The true role of management is to make risk-taking possible. Executives can't order their staffs to be creative—they have to provide the conditions where creativity flourishes. Such conditions include strong staff morale, the feeling that someone is listening and the conviction that good work will be rewarded."²⁴ The next conclusion follows this same line.

CONCLUSION 7. *Once an innovator has been identified, support him, but as much as possible let him work unencumbered by bureaucracy.* Kurth states it this way:

[P]rovide a zealot who can produce results with adequate organizational support, power and funds. Let the leader assemble his own team and attack the problem. Give him responsibility and discretion. Free him insofar as possible of bureaucratic layers of oversight authority. So long as he produces results, let him alone to do so.

When Hostettler took over the Tomahawk program, he received exactly the kind of support and freedom being discussed. As he relates it:

[A]fter about three weeks, I submitted my budget. I went over and briefed, as you might imagine, everybody in the Pentagon. My boss, of course, first, always Jack Williams first. And then . . . ultimately, the Secretary of the Navy, who approved the program on the spot. Never has anyone walked over, and just

²²Interview with Vice Admiral Joe Williams, USN (Ret.), 26 August 1993.

²³Most Program Managers interviewed acknowledged a debt to the success of the Polaris Program. According to Vice Admiral Joe Williams, that success was primarily the result of the efforts of then-Captain (later Vice Admiral) Levering Smith, who was "the best project manager you've ever had in the US Navy." (Williams interview, 26 August 1993).

²⁴Edwin Diamond, *Readers' Digest*, January 1994, p. 108.

bang, "I need this much time, I need these many dollars and I need these people, and with that I think we are going to give it a good shot. I can't promise you anything, but I can tell you this, we are going to give it a hell of a shot." And he sat there and said, "Go, you got it." There wasn't even any discussion. You talk about support, I got what I asked for, nobody even hedged on it; nobody threatened me. I knew what was at stake. We had the support we needed, I got what I wanted and they left me alone.²⁵

Identifying innovators, however, may not be any easier than identifying pornography. As the late Justice Potter Stewart remarked, "I know it when I see it." Innovators have been termed visionaries by their peers. To create a revolution, Marion Oliver believes, it takes three generations. "The visionary comes along and it takes him about a generation to convince everybody that his vision is plausible. You recognize that [stage] when you start calling it reform instead of revolution. Then the second generation comes along, understands the vision, carries it out, and perpetuates it for about a generation. Finally, the third generation comes along and [sees the revolution as the normal way of doing things]. . . . Then you are ripe for the next visionaries."²⁶

CONCLUSION 8. Both inter- and intra-Service rivalry stimulates innovation. As noted above, Rosen concluded from his research that innovation requires "a new theory of victory" which results in an ideological struggle within a particular Service. And the Tomahawk case study demonstrated how inter-Service rivalry can be used to promote innovation. Davis believed, however, that inter-Service rivalry was more important for selling an innovation within a Service than it was for its initial development. He noted in his case study on the development of carrier-delivered nuclear weapons:

The bitter conflict between the Navy and the Air Force was neither the stimulus for nor a major initial part of the arguments for the . . . proposal, but the conflict related to the eventual success of the . . . proposal within the Navy in that it encouraged naval officers to be receptive to new ideas—especially a new idea that seemed in keeping with the major emphases in defense policymaking in the Congress and in the White House.²⁷

²⁵Holstettler interview, 15 July 1993.

²⁶Interview with Mr. Marion Oliver, former Johns Hopkins Applied Physics Laboratory Tomahawk project manager, Washington, D.C., 9 September 1993.

²⁷Vincent Davis, *The Politics of Innovation: Patterns in Navy Cases*, Monograph Series in World Affairs, Vol. 4, No. 3 (Denver: University of Denver, 1967), p. 21.

Perhaps the most disturbing inference which can be drawn from this conclusion is that the movement toward joint programs and inter-Service cooperation, because of the resultant centralization of control and increase in organization size, will inevitably lead to less innovation. Kurth asserts that the "combination of strong service values and . . . central control reduces service conflict to the satisfaction of many, but it also inhibits innovation. The fifties were filled with service conflict and military innovation while the sixties were free of conflict but stultified."²⁸ Nevertheless, there is a down side to decentralization. "Decentralization, James Q. Wilson has theorized, produces more ideas for innovation with less likelihood that they will be adopted. On the other hand, Wilson concluded, centralization produces fewer innovative ideas but a greater assurance that they will be adopted."²⁹

CONCLUSION 9. Congressional support for innovation is absolutely essential for success—because Congress controls the purse strings—but unilaterally seeking such support may adversely affect an innovator or a Service since it can isolate them from their larger bureaucratic organizations (if they have differing agendas). "As somebody had once said, and it's true, 'Whatever else the program manager ever does, his first responsibility is to get the gold.' Because if he doesn't do that, all the rest of it is worthless."³⁰ During his tenure as CNO, Zumwalt "made it a habit to try and have a get together with every member of Congress every year and [he] averaged close to 400 Congressmen and . . . 90 Senators every year."³¹ Kurth concluded that, "It may be incorrect to consider the President and Congress as forces 'outside' the military. In the management of military innovation, they are 'internal' powers who frequently exercise institutional leadership over the military services."³² This has never been more clearly demonstrated than by the cruise missile case. Regardless of the strategic and historic value of the ALCM, the Air

²⁸Kurth, *op. cit.* in note 14, p. 45.

²⁹*Ibid.*, p. 364. See also James Q. Wilson, "Innovation in Organization: Notes Toward a Theory," in James D. Thompson, ed., *Approaches to Organizational Design* (Pittsburgh: University of Pittsburgh Press, 1966), p. 200.

³⁰Hostettler interview, 15 July 1993.

³¹Interview with Admiral Elmo R. Zumwalt, Jr., 28 May 1993.

³²Kurth, *op. cit.* in note 14, p. 78.

Force preferred manned penetrating bombers. However, the intervention of Congress, the Department of Defense and the White House led to the development of long-range standoff cruise missiles. But this external intervention, by deliberately ignoring the central interests of the Air Force, delayed rather than promoted the Service's acceptance of the ALCM.

But there is also a dilemma for innovators as they seek extra-organizational support for their programs or ideas. There is ample evidence that large organizations, including the Navy, resist innovation. Resistance increases as innovators attempt to gain support outside of Navy and Department of Defense channels. Thus, the innovator runs grave career risks by seeking unofficial contacts with members of Congress or their staffs.

When an innovator manages to convince his Service that his program should be supported in the face of higher political opposition, the organization itself runs some risks. Not rarely, the military's political masters promote an agenda which differs from the preferred military program. In such cases, access to Congress is fraught with additional risks (i.e., not only to individual careers but to institutional support for other desired programs—there is not an inexhaustible supply of "silver bullets"). A Secretary of Defense memorandum of 22 March 1961 warned Pentagon staffs:

It is expected that witnesses will carefully avoid volunteering views differing from the budget, either on the Record or off the Record. While direct questions at hearings must be answered frankly, it is expected that a witness who feels that he must set forth a personal view inconsistent with the President's budget will also point out that the President's judgment on the matter was reached from his overall perspective as head of the Government and in the light of overriding national policy. The witness should make clear that his personal comments are not to be construed as a request for additional funds.³³

When Harold Brown became Defense Secretary during the Carter Administration, he was a bit more sophisticated. As explained by Admiral Doyle:

[B]efore the annual budget process he'd call the people down who were going over from all the services to testify [before Congress], and he'd say these are the ground rules, including for his political people. 'Now for the political people, if you can't go over and testify in favor of the decision I made or the [Administration's] program, then it's time for you to submit your resignation, because you're political people.' He then said, 'There's a different role for the

³³ Quoted in Kurth *op. cit.* in note 14, p. 93.

military people, and they can, if asked, give their personal opinion provided that they first state the Administration's position.' I always admired him for that and I think that's quite proper. So you always made sure that the staff knew the question to ask you!³⁴

The "Rickover syndrome," i.e., the fear that an individual or Service may gain an independent power base outside of the military chain of command, plays more to the anxieties of bureaucrats in this area than any other.

Conclusion 10. *Innovations have a better chance of surviving the rigors of the budgetary system if there have been successful prototype tests which demonstrate their feasibility.* Both the Tomahawk and Aegis programs were able to demonstrate the viability of the technology at critical junctures. Even if future procurement strategies involve leapfrogging a generation, the successful development and testing of prototypes appears essential for maintaining funding support. Davis notes the Navy faced this dilemma when trying to develop a carrier-delivered nuclear delivery system.

In response to [Commander John T. "Chick"] Hayward's request that [Vice Admiral Forrest] Sherman get from Congress a general endorsement of Navy plans within the area of nuclear weapons delivery systems, Sherman told him that Congress might conceivably buy the Navy idea but only after the Navy had first demonstrated on its own initiative a clearcut capability—although perhaps quite crude at the outset—for long-range strategic bombing with airplanes that could carry then-existing atomic bombs.³⁵

CONCLUSION 11. *The set of ideal characteristics required in an program manager remains unresolved.* Davis asserted that what sets innovators apart from others is special education or knowledge that allows them to promote the desired innovation. Locke insists "experience is equally, if not more, important as education."³⁶ Locke particularly insisted that Program Managers have relevant experience as both operators and as Deputy Program Managers. Meyer, on the other hand, was a strong advocate for placing technically educated people with appropriate engineering skills in charge of projects. Thus, he believed that programs could only fail because of technical

³⁴Interview with Vice Admiral James H. Doyle, USN (Ret.), 11 August 1993.

³⁵Davis, *op. cit.* in note 28, p. 15.

³⁶Interview with Rear Admiral Walter Locke, USN (Ret.), 5 May 1993.7.

challenges and that management problems were more easily overcome. Others disagreed, believing with Locke that experience, particularly operational experience, was what really mattered. For example, Admiral Doyle said, "You have to have somebody with some operational background, not just the technical aspect."³⁷ Even Hostettler, a strong admirer of Meyer, stated, "[Y]ou cannot turn the management of these jobs over to a bunch of engineers. You need them. Wayne Meyer was an exception, he's an engineer but was so smart, and was so beholden to the fleet, that you'd never know he wasn't in command. He thought fleet first. It always helps to get somebody out of the fleet because they've been there and know how aggravating it is when something doesn't work. . . . [T]hat's why I think it's very difficult to put engineers in charge."³⁸

The above discussion makes it clear that writing a job description for a program manager will never guarantee program success. Without question, some technical background is required, but other factors (such as, operational qualifications, management experience, etc.) are equally important considerations.

Implications for the Future

Although there is consensus about the need for continued innovation in the Navy,³⁹ nothing in organizational theory or this study provides much hope that this will be an easy or smooth process. Identifying and supporting innovators appear to be the most challenging problems—you simply can't order someone to be creative. There is currently an increasing interest in revolutions in military affairs but it is too early to conclude that the rhetoric will produce results.

We stand on the brink of a new era and whether we push boldly forward, or are dragged into it forcefully, depends on maintaining support for research which leads to innovation. On the positive side, it has been argued elsewhere that

³⁷ Doyle interview, 11 August 1993.

³⁸ Hostettler interview, 15 July 1993.

³⁹ "In his speech opening the [1994 Current Strategy Forum, Secretary of the Navy] Dalton used the words 'innovative' and 'innovation' 32 times." (John W. Mashek, "Navy strategy session in R.I. uneasy with Clinton policies," *Boston Globe*, 17 June 1994, p. 20.)

... historically the most profound RMAs are peacetime phenomena ... driven ... by the need to make more efficient use of shrinking resources, by reacting to major changes in the security environment or by recognizing the possible implications of new inventions or techniques for their art. Prolonged peace provides the time and resources for experimentation. Equally important, this is the period of least risk if wrong choices are made."⁴⁰

The fact that "military research and development spending has been holding fairly constant despite cuts in the procurement of weapons"⁴¹ is another positive sign but may not last.⁴² The establishment of Joint and Naval Doctrine Commands to complement those of the Army, Air Force and Marines also has the potential to fuel innovative thought.

While extended periods of peace are unarguably the best time for experimentation and innovative thinking, this study provides scant support that such will be the case. Maintaining a national focus on security is very difficult when not faced with a peer competitor challenging the public's welfare. And the public's sentiments are invariably mirrored in Congress. With Congressional support being so essential for sustaining innovative programs, both its lack of focus and diminishing military foundation are cause for concern. Davis concluded that weapons systems innovation in the Navy has generally had "a heightened degree of receptivity" when Congress has tried to strengthen any segment of the armed forces in response to an increasingly threatening adversary.⁴³ This observation suggests that in today's Congressionally mandated drawdown period, following the collapse of the Soviet Union, the Navy will tend to resist innovation despite all the rhetoric concerning its importance. If true, organizational caution could be the "enemy within" during the current revolution in military affairs.

Even though the establishment of doctrine commands have potential for encouraging innovation, our fear is that they will ultimately find themselves trying to justify old doctrine rather than pursuing

⁴⁰James R. Fitzsimonds and Jan M. Van Tol, "Revolutions in Military Affairs," *Joint Force Quarterly*, Spring 94, pp. 26-7.

⁴¹Philip Finnegan, "U.S. Firms Find Profit in Worldwide Consolidation," *Defense News*, 19-25 July 1993 [Nexis].

⁴²See Eric Pianin, "House Panel's Proposal Would Cut Defense Research in Half," *Washington Post*, 28 Jun 94, p. 15; "Reforming the Pentagon: An Inside Job," *Technology Review*, April 1994; and Michael Kenward, "How the West could lose the peace; military research and industrial innovations," *New Scientist*, 8 May 1993 [Nexis].

⁴³Davis, *op. cit.* in note 28, p. 10.

new ones. Typically, doctrinal development means trying to freeze ideas—innovation means just the opposite. Since some influential strategists have predicted that the already blurred lines demarcating Service roles and missions may disappear altogether,⁴⁴ having a single organization *think* about total force doctrine is probably wise; however, having them spend their time publishing and justifying accepted doctrine will inevitably stifle innovation. It may also excessively dampen inter-Service rivalry which has in the past been an excellent source of innovation.

Paul Bracken, in an extremely insightful article, asserts that “the biggest unanalyzed problem facing the United States is sustaining its military and strategic competitive advantage Nothing lasts forever. This is as true of U.S. military superiority as anything else.”⁴⁵ Two factors identified during this study which tend to stifle or slow the rate of innovation, and which run counter to the strategy recommended by Bracken, are starting to appear. They are:

- decreasing research and development. The proposed reduction or consolidation of national laboratories and threatened cuts in university research and development may be only the first volleys. Bracken focuses on the Defense Department’s test centers, laboratories and war colleges and believes “these centers need support and protection from immediate pressures.”⁴⁶ Perhaps Congress was listening, because the first round of cuts has been aimed at civilian sector. But it has been argued that such cuts “would rob the military of its technology leadership while doing little to solve the defense budget problem.”⁴⁷

- traditional aversion to military mavericks. Because of this aversion, the best chance for innovation to succeed remains pursuing a strategy of evolutionary rather than revolutionary change. It will likely be the combination of evolutionary technological innovations

⁴⁴Ricks, *op. cit.* in note 7.

⁴⁵Paul Bracken, “The Military After Next,” *The Washington Quarterly*, Autumn 1993, p. 165.

⁴⁶*Ibid.*, p. 171.

⁴⁷Ralph Vartabedian, “Colleges Fear Research Cuts by Pentagon,” *Los Angeles Times*, Washington edition, 22 July 1994, p. 1. In the same article, Anita Jones, the Pentagon’s director of defense research and engineering, is quoted as saying, “This reduction in defense research would have very dire results. . . . You will not see them immediately, but over the long term they would be severe.”

and doctrine that will eventually result in further revolutionary changes. Bracken says that the Services should "encourage innovation in the formal learning parts of the defense establishment designed to foster innovations and new thinking. New concepts will be worked out and tested in the services, war colleges, operational testing centers, laboratories, and gaming centers."⁴⁸ Yet, this may not happen unless steps are taken "to strengthen independence and tolerance for diversity" within these organizations.⁴⁹

As Secretary of the Navy John Dalton has said, "[T]he bottom line is that our Navy today cannot afford to fail when it comes to innovation. We cannot afford to be viewed as a 'closed corporation' unresponsive to new inventions—both in new technology and in strategic thought."⁵⁰ If the Naval or other Services do fail, Yogi Berra will have proven to be as much a prophet as a philosopher when he said, "The future ain't what it used to be."

⁴⁸Bracken, *op. cit.*, p. 171.

⁴⁹*Ibid.*, p. 172.

⁵⁰The Honorable John H. Dalton, Secretary of the Navy, "Remarks prepared for the Current Strategy Forum," Naval War College, Newport, RI, 14 June 1994, pp. 7-8.

APPENDIX A.
INDIVIDUALS INTERVIEWED

INTERVIEW LIST
(In alphabetical order)

Mr. Al Best
Dr. Andy Borden
Vice Admiral Ken Carr, USN (Ret.)
Honorable William P. Clements
Dr. Malcolm Currie
Vice Admiral James H. Doyle, USN (Ret.)
Dr. John Foster
Rear Admiral James B. Greene, USN
Mr. Ross R. Hatch
Mr. Bob Holsapple
Rear Admiral Stephen Hostettler, USN (Ret.)
Rear Admiral George A. Huchting, USN
Mr. Richard Hunt
Dr. Alexander Kossiakoff
Rear Admiral Ronald Kurth, USN (Ret.)
Rear Admiral Walter Locke, USN (Ret.)
Admiral Robert L. J. Long, USN (Ret.)
Ms. Adelaide Madsen
Rear Admiral Wayne E. Meyer, USN (Ret.)
Mr. Gerry Miller
Rear Admiral David R. Oliver, USN
Mr. Marion Oliver
Mr. William O'Neil
Mr. Robert Parker
Captain Brian Perkinson, USN (Ret.)
Honorable William Perry
Dr. Robin Pirie
Rear Admiral Donald P. Roane, USN (Ret.)
Rear Admiral Conrad J. Rorie, USN (Ret.)
Mr. Jeff Sands
Rear Admiral George Wagner, USN
Vice Admiral J. D. Williams, USN (Ret.)
Vice Admiral Joe Williams, USN (Ret.)
Dr. Albert Wohlstetter
Admiral Elmo. R. Zumwalt, Jr., USN (Ret.)

1985 Interview List
(In alphabetical order)

Captain D.H. Barnhart, USN
Captain G. W. Dunne, USN
Captain John Fedor, USN
Mr. Robert E. Gray
Mr. Donald May
Captain L.H. Sebring, USN (Ret.)
Vice Admiral Thomas Weschler, USN (Ret.)